09[illegible]389.030801

FIG. 1A (FLOW PARTITIONING)

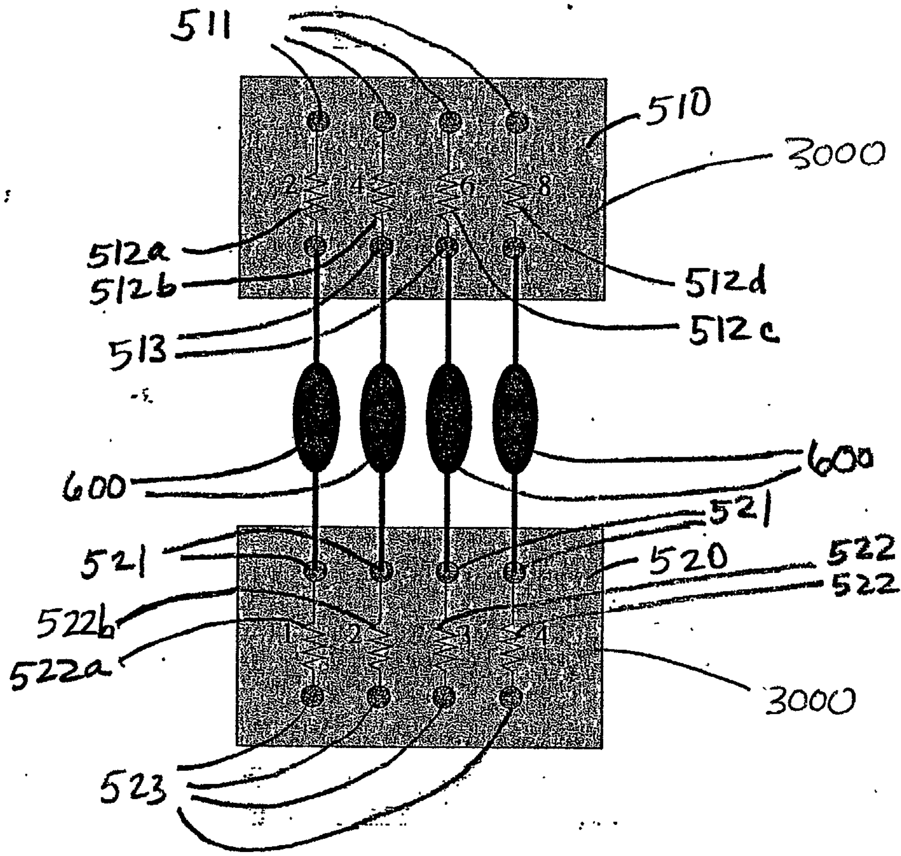

511
510
3000
2
4
6
8
512a
512b
512d
513
512c
600
600
521
521
520
522c
522d
522b
522a
1
2
3
4
3000
523

FIG. 1B (PRESSURE PARTITIONING)

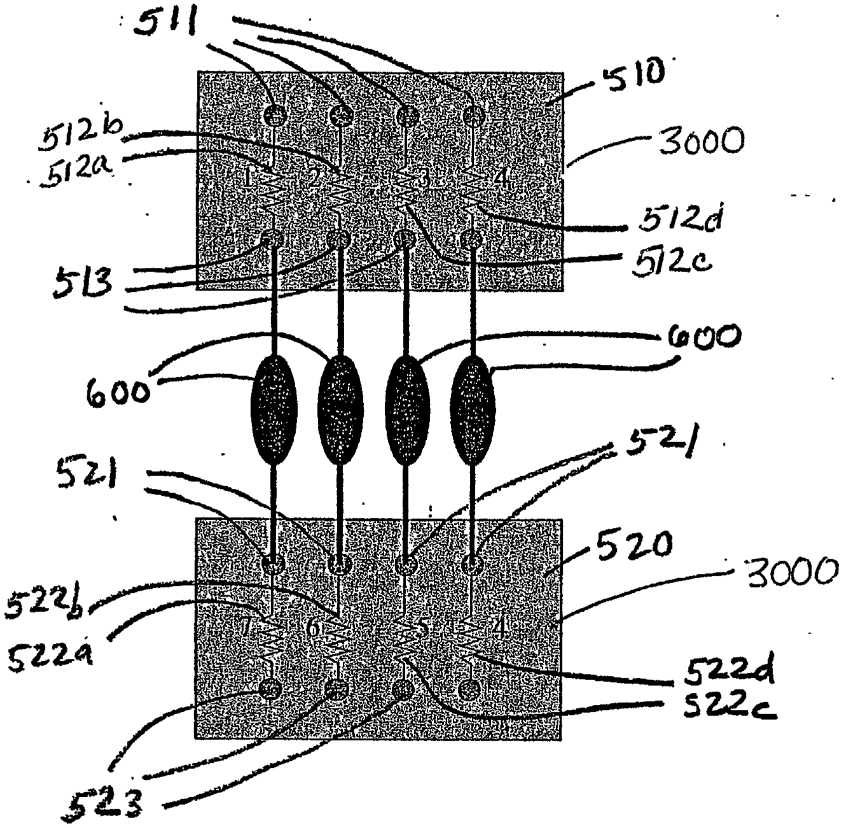

511
510
3000
512b
512a
1
2
3
4
512d
512c
513
600
600
521
521
520
3000
522b
522a
7
6
5
4
522d
522c
523

FIG. 1C (FLOW / PRESSURE PARTITIONING)

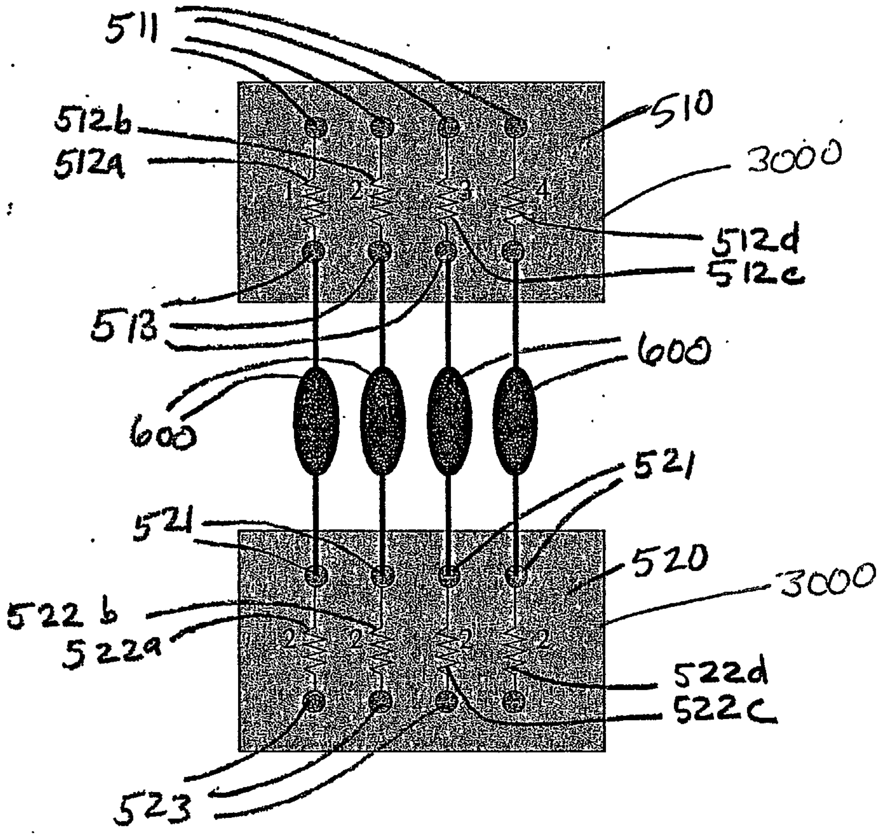

511
512b
512A
510
3000
1
2
3
4
512d
512c
513
600
600
521
521
520
3000
522 b
522a
2
2
2
2
522d
522C
523

FIG. 2A

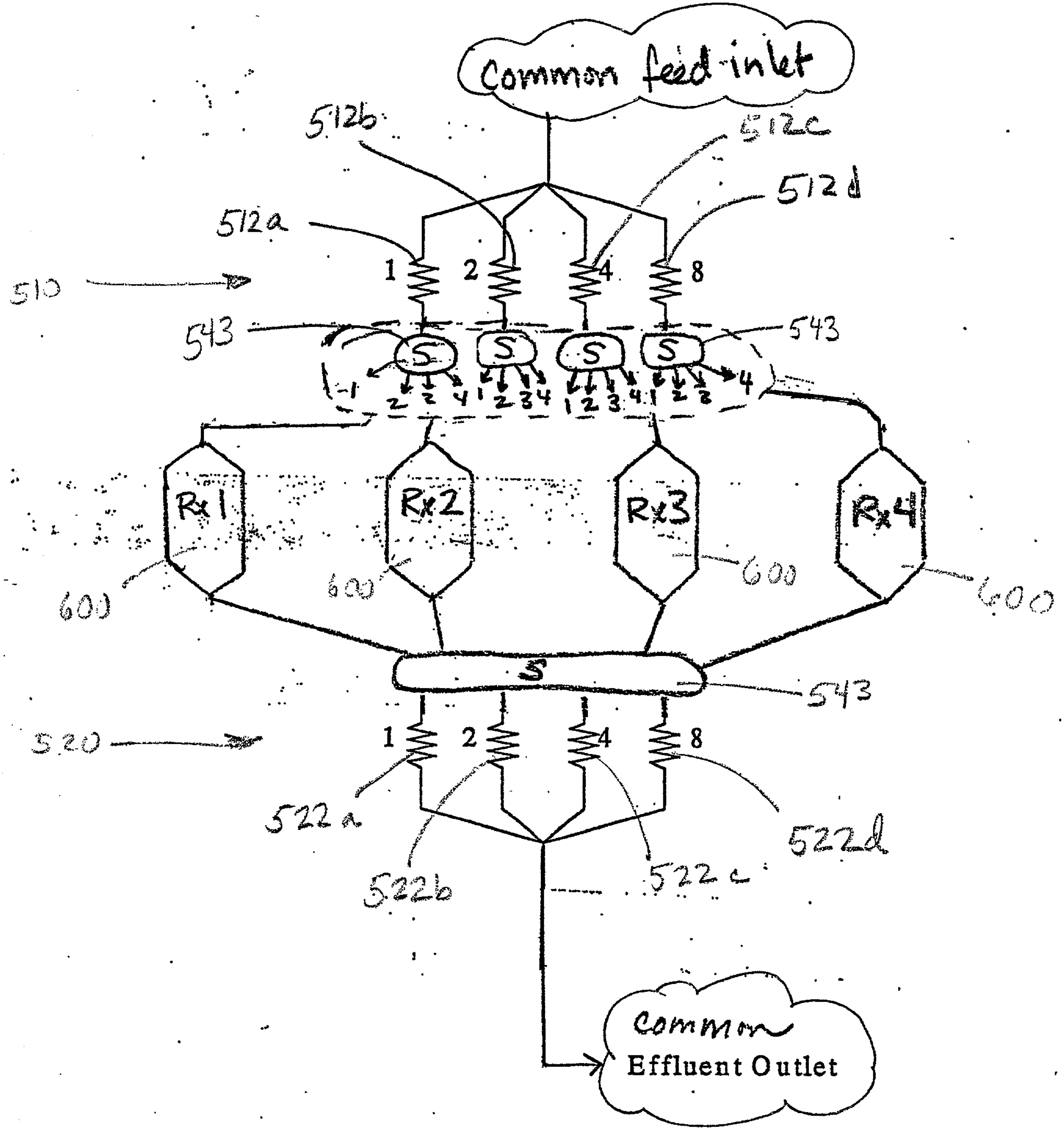

Common feed inlet
S
S
S
S
1 2 2 4
1 2 3 4
1 2 3 4
1 2 3 4
Rx1
Rx2
Rx3
Rx4
S
Common
Effluent Outlet

FIG. 2B

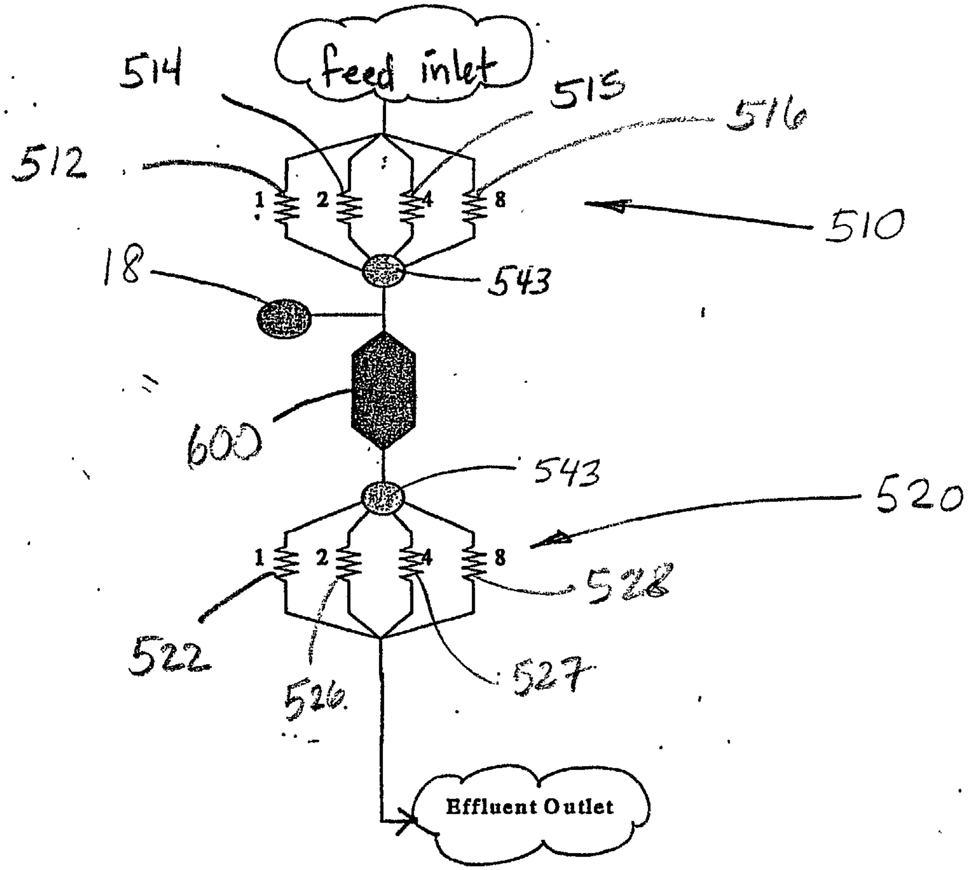

feed inlet
Effluent Outlet

FIG. 2C

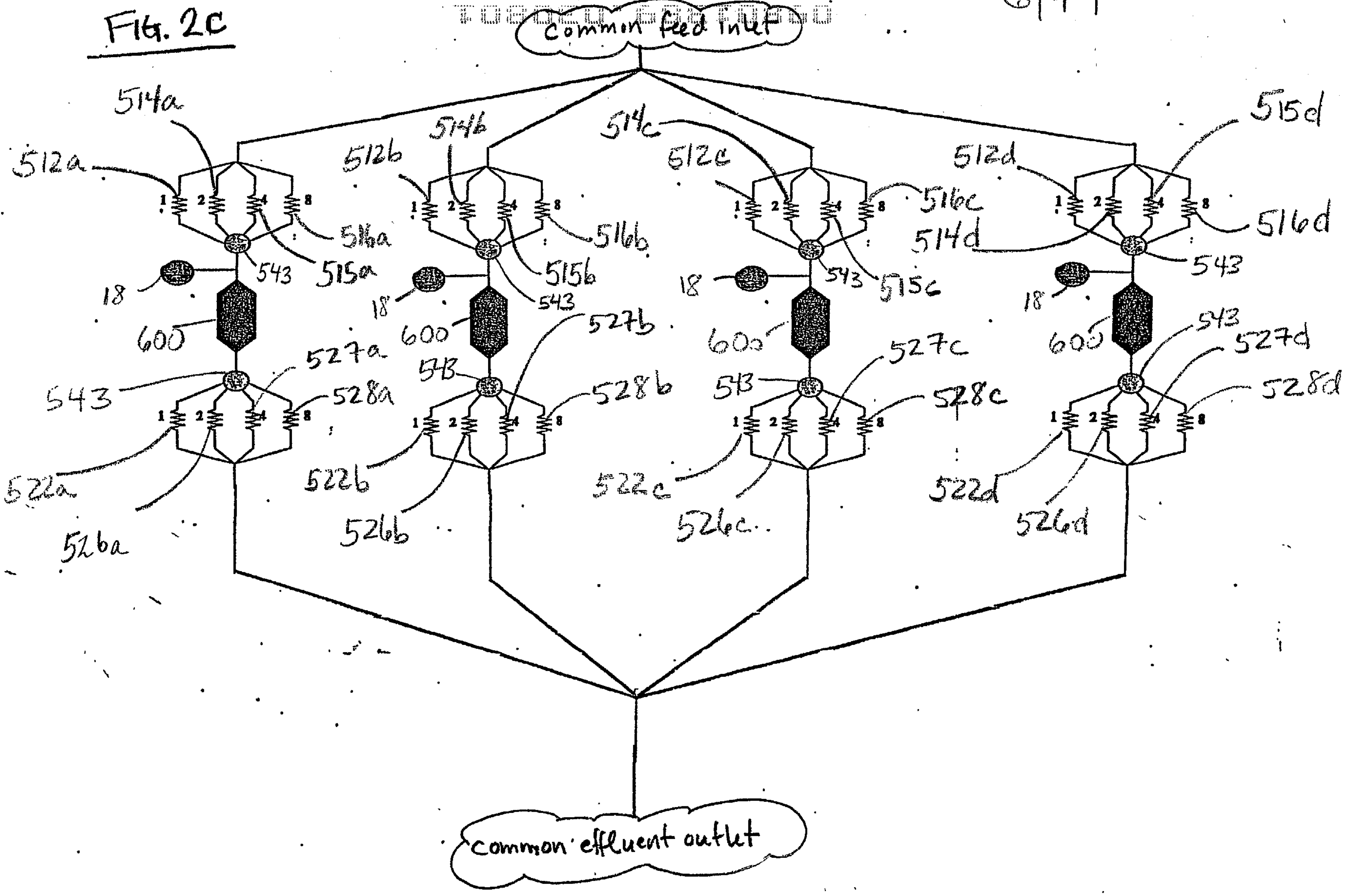

common feed inlet
common effluent outlet
]

FIG. 2D

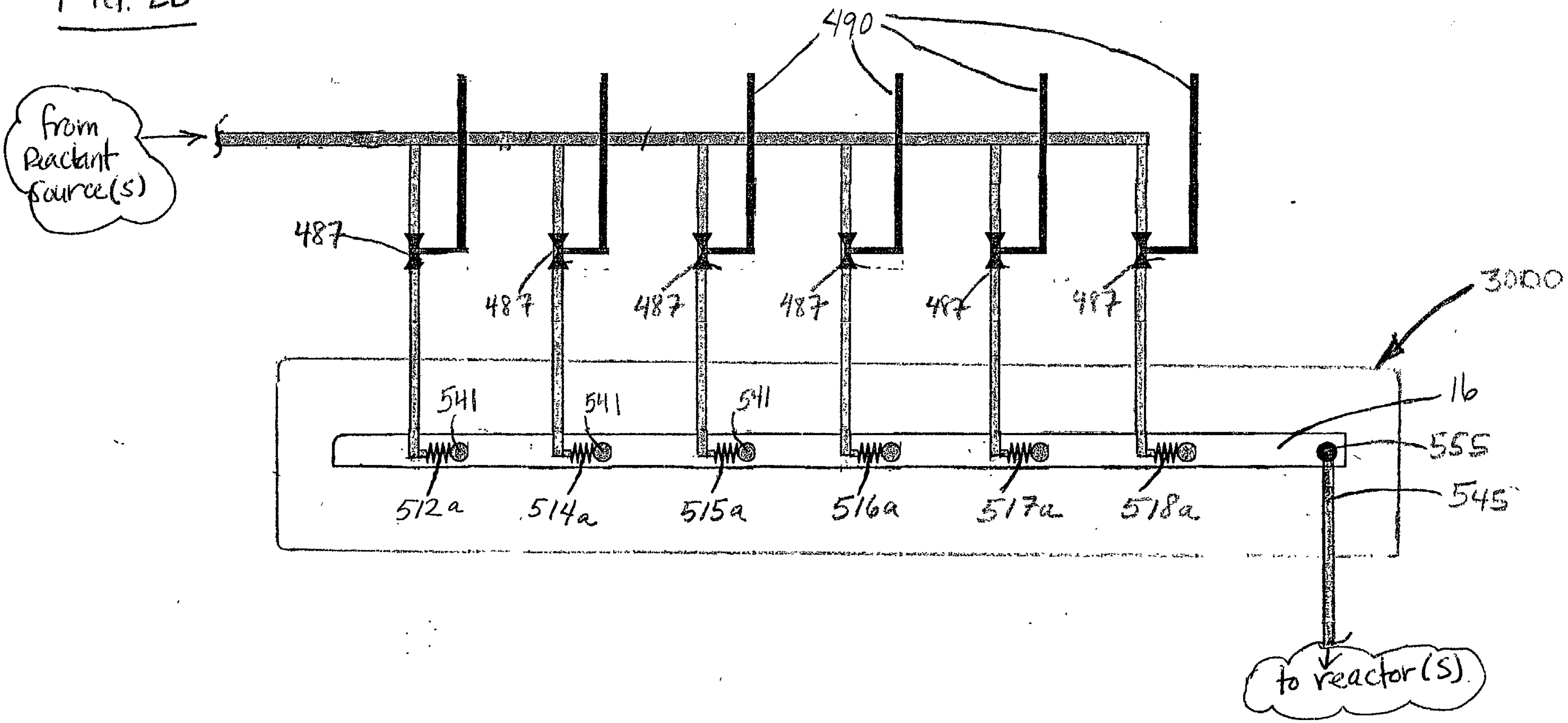

from Reactant source(s)
to reactor(S)

FIG 2E

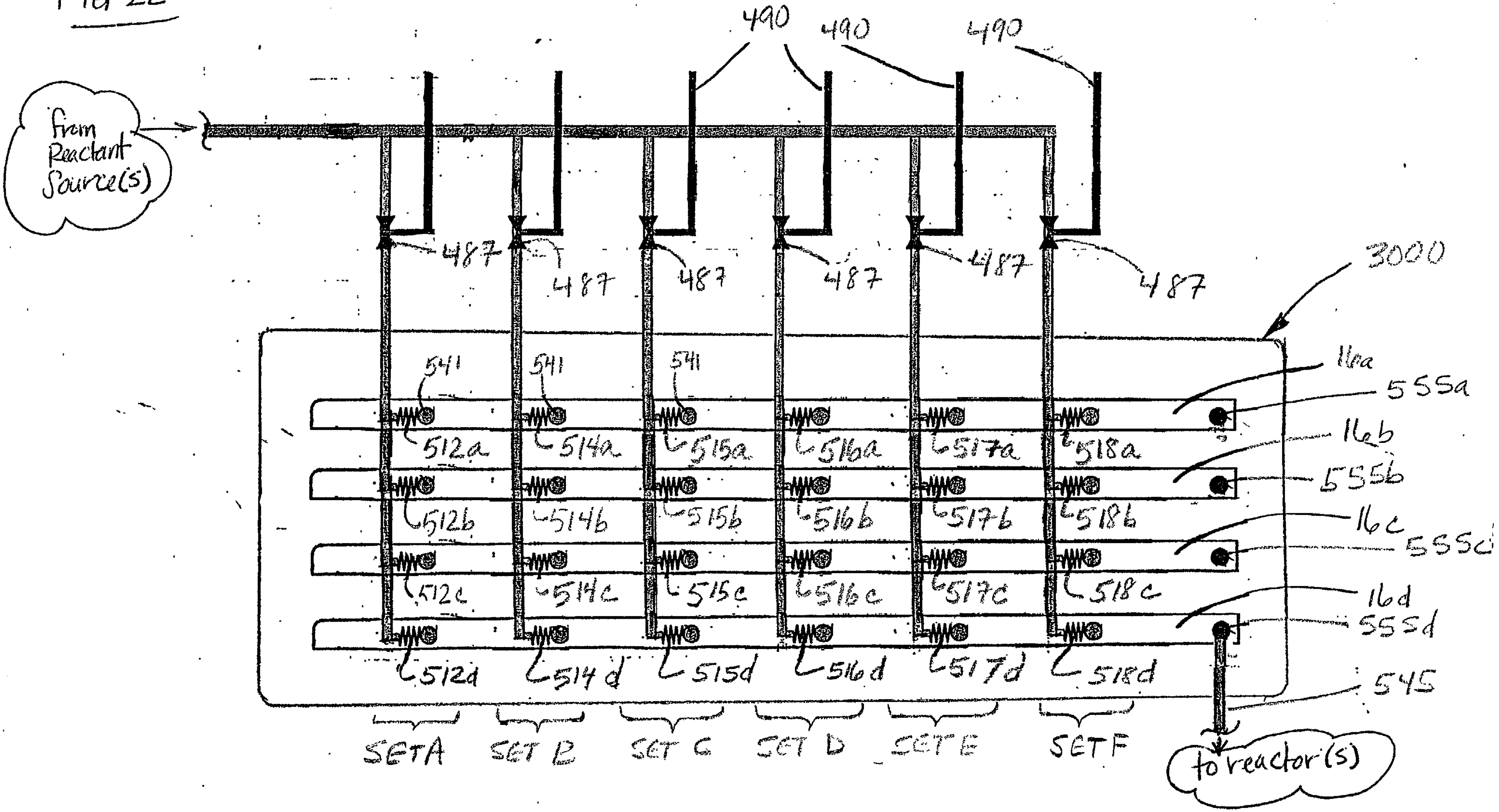

from Reactant Source(s)
SET A
SET B
SET C
SET D
SET E
SET F
to reactor(s)

Fig. 2F

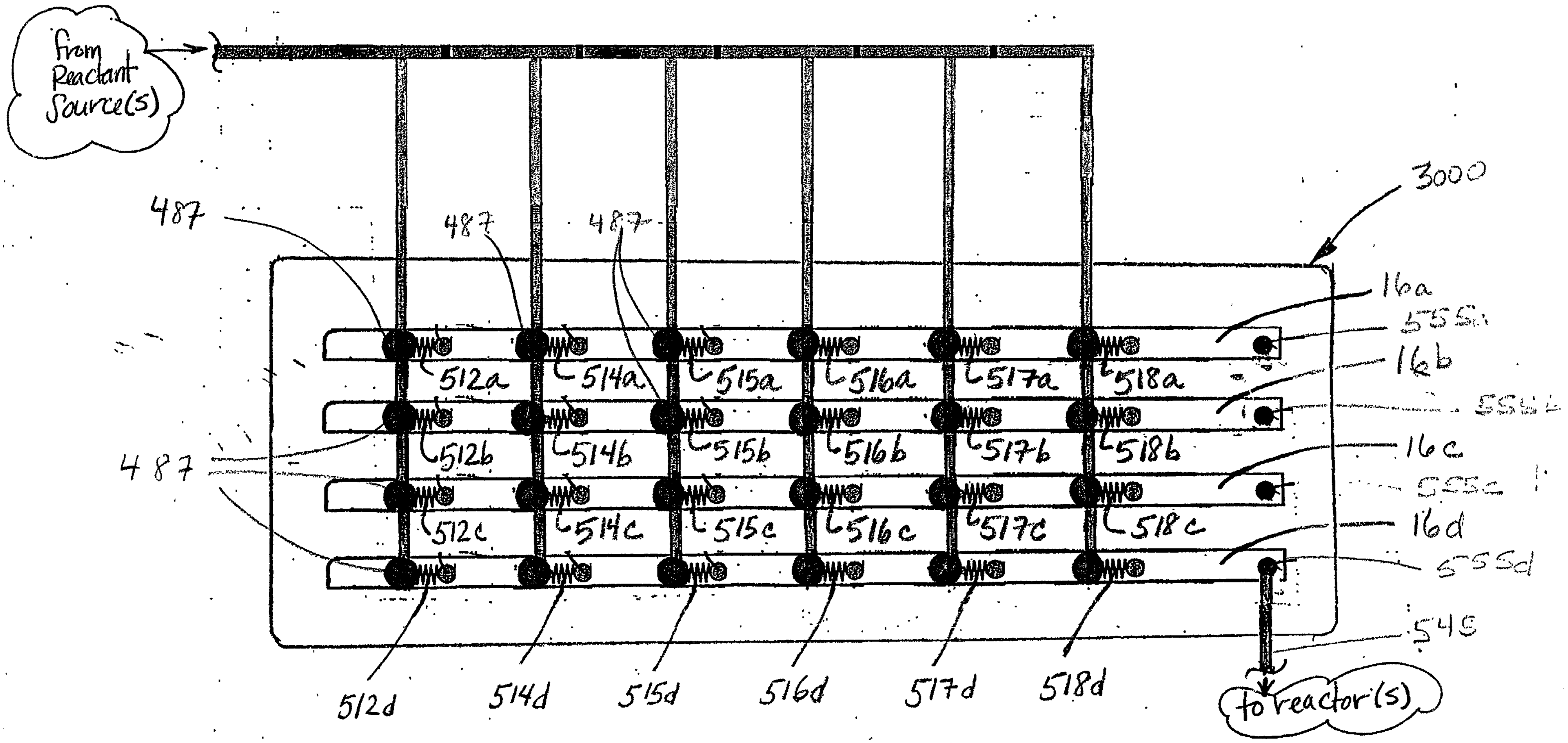
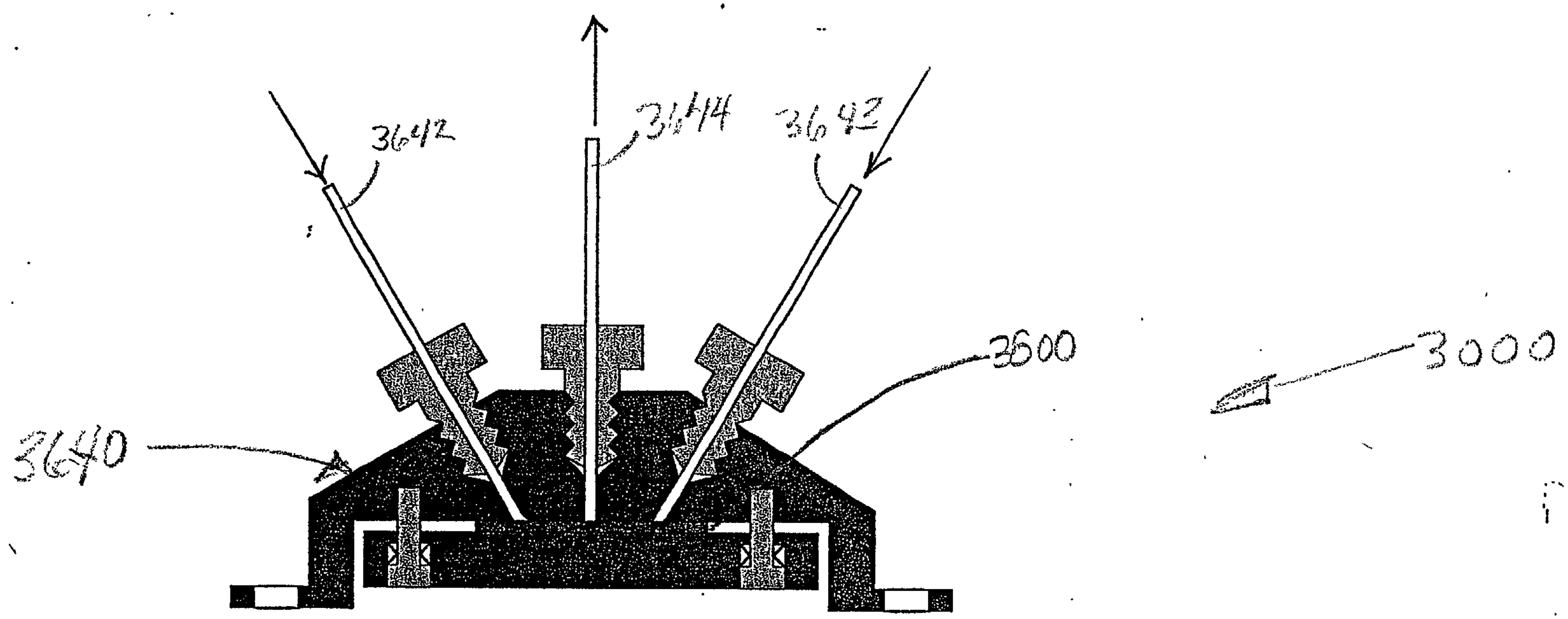

from Reactant Source(s)
to reactor(s)

FIG. 3A


3642
3644
3642
3600
3000
3640

09801389.030801

FIG. 3B

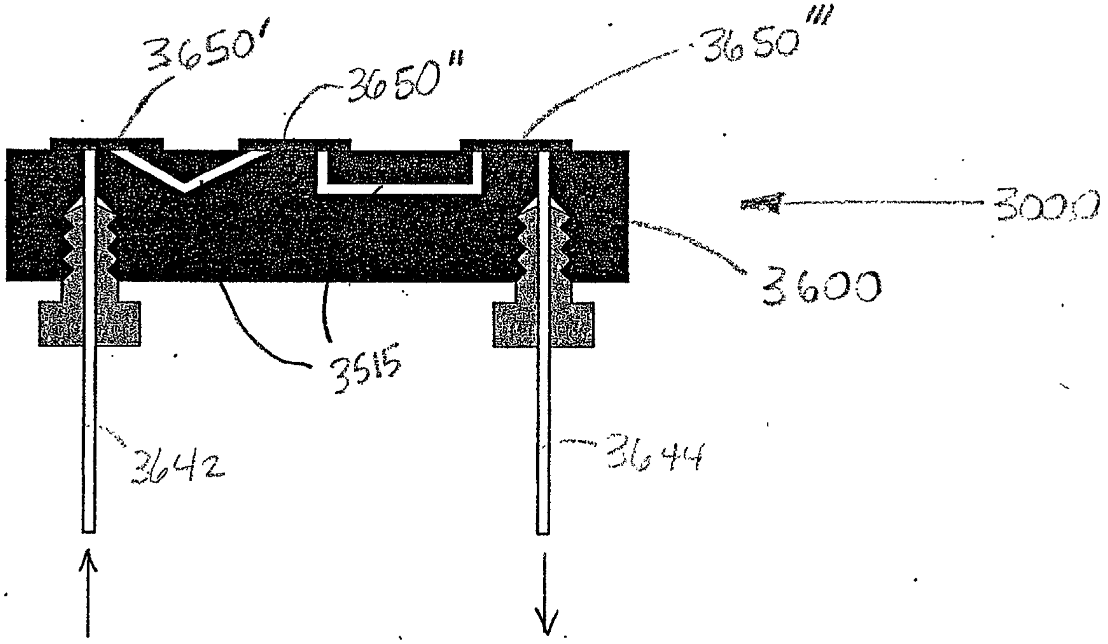

3650'
3650''
3650'''
3000
3600
3515
3642
3644

Fig. 3C

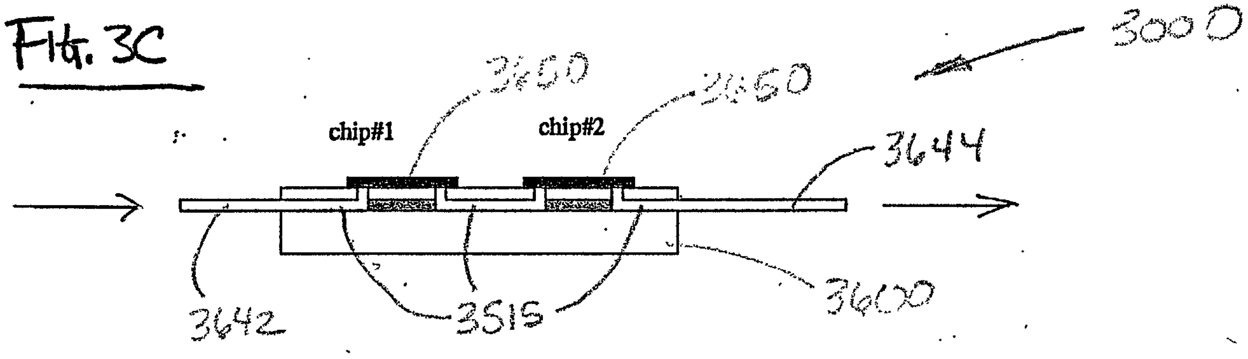

chip#1
chip#2

Fig. 3D

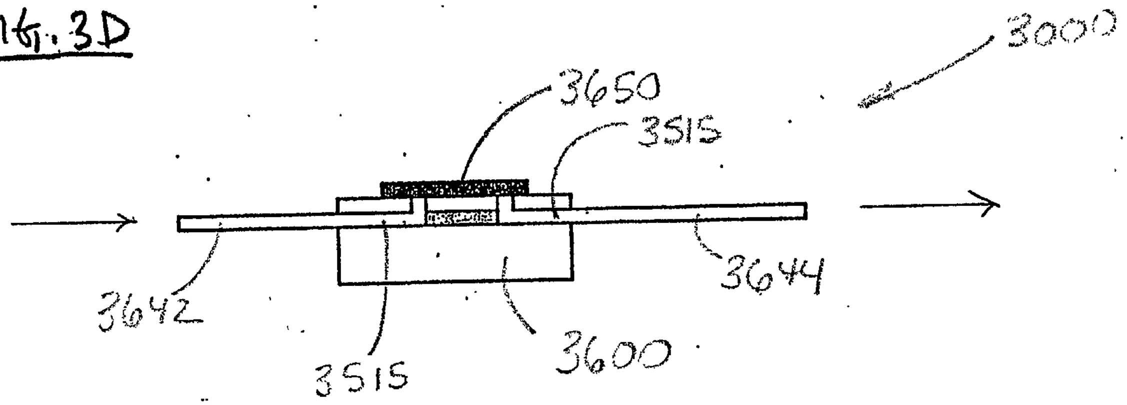
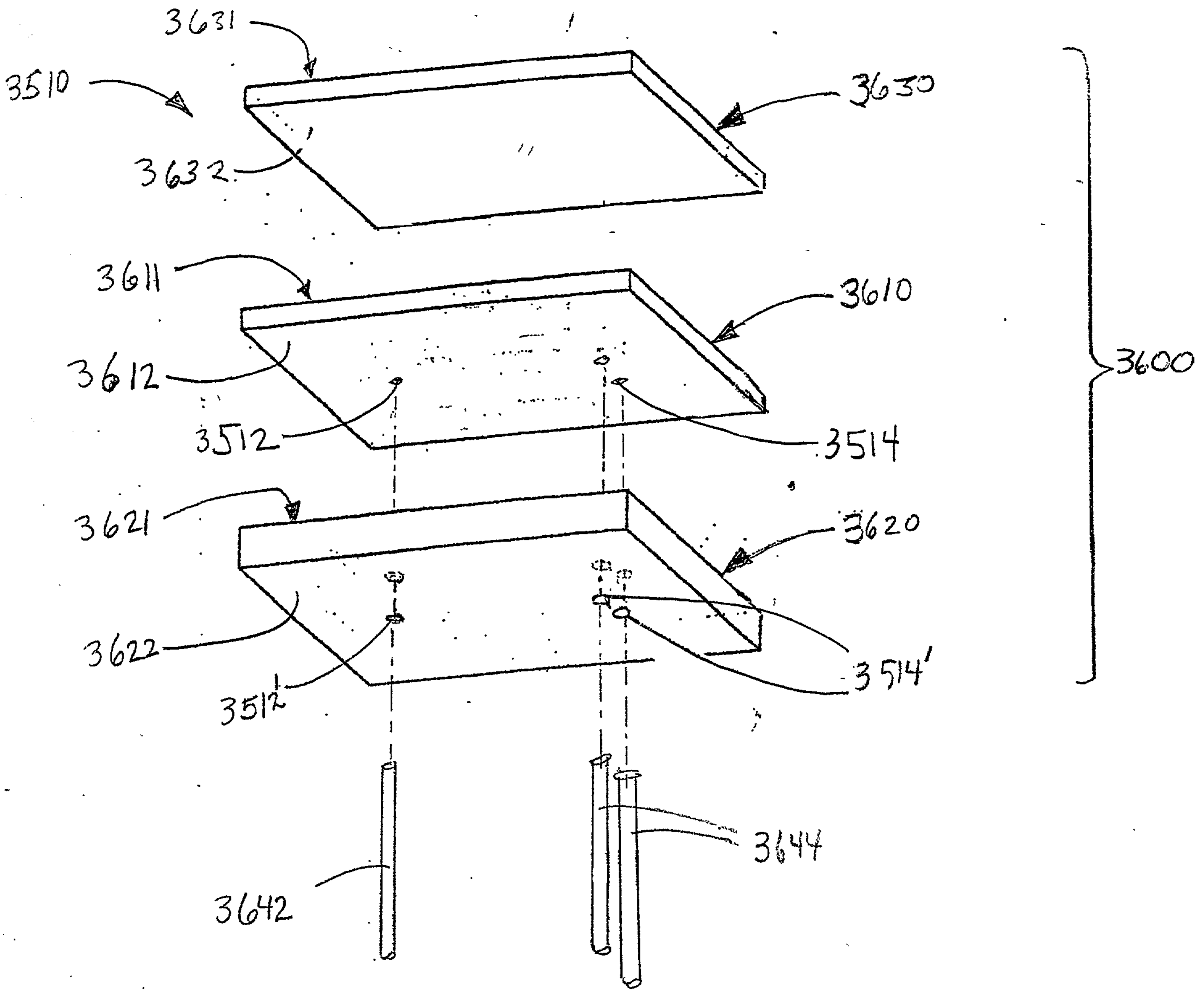


Fig. 3E


3631
3510
3630
3632
3611
3610
3612
3600
3512
3514
3621
3620
3622
3514'
3512'
3644
3642

09801389.030801

FIG. 3F

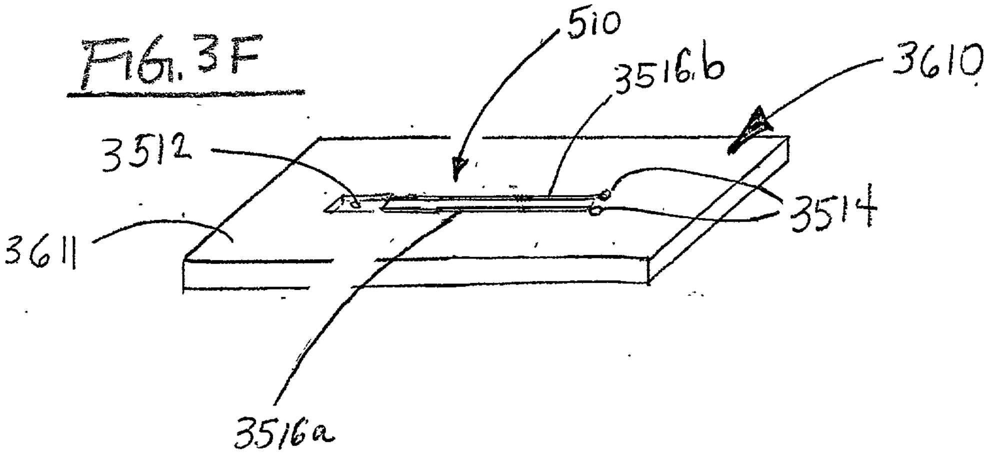

510
3516b
3610
3512
3514
3611
3516a

FIG. 3G

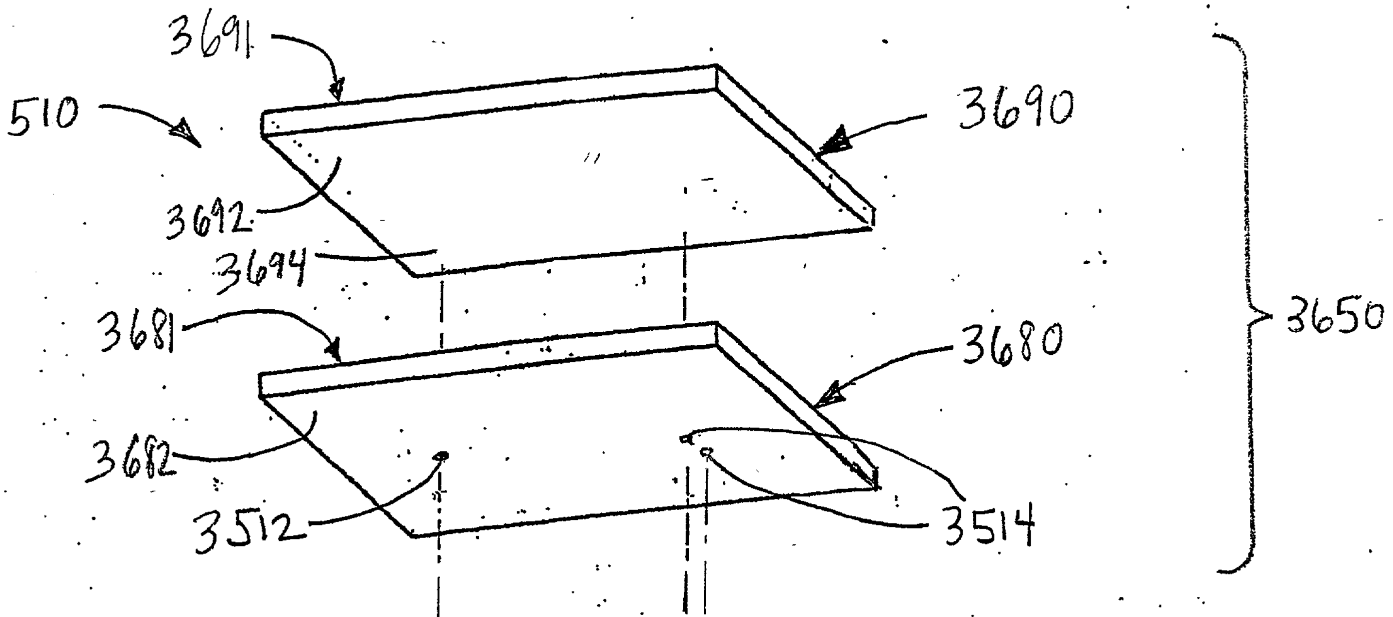

3691
510
3690
3692
3694
3681
3680
3650
3682
3512
3514

FIG. 3H

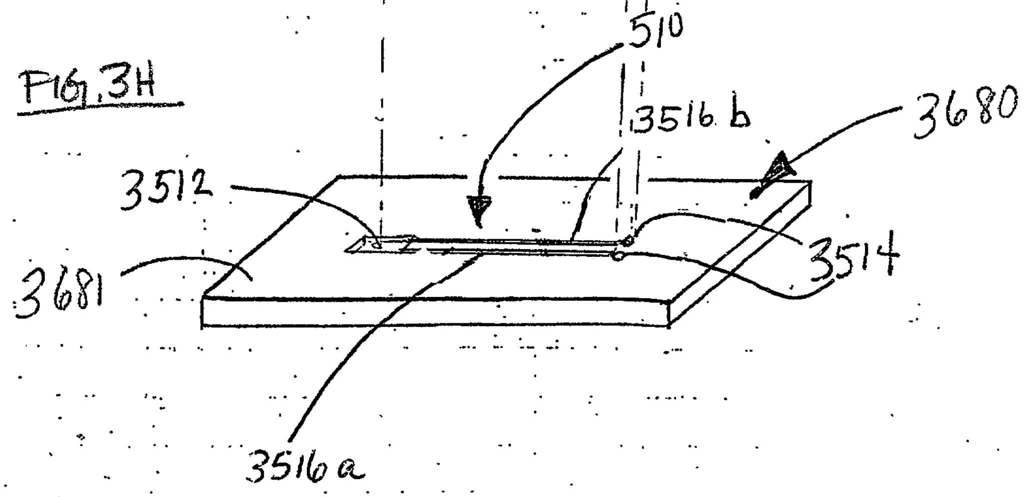

510
3516 b
3680
3512
3681
3514
3516 a

FIG. 3I

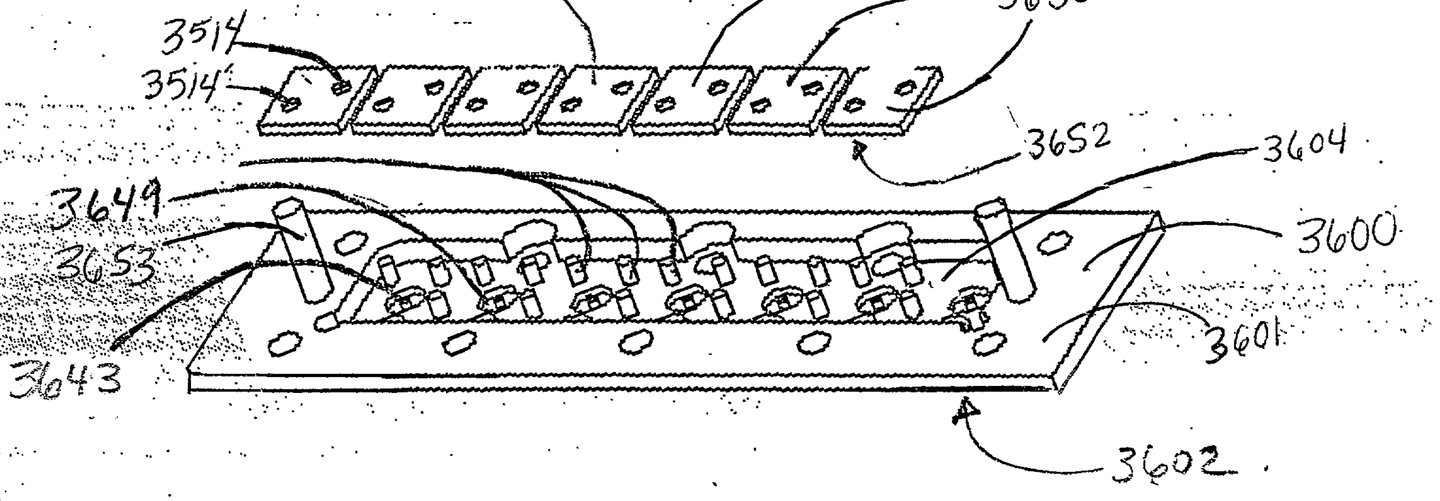

3651
3514
3514
3650
3652
3604
3649
3653
3600
3643
3601
3602

Fig. 4A

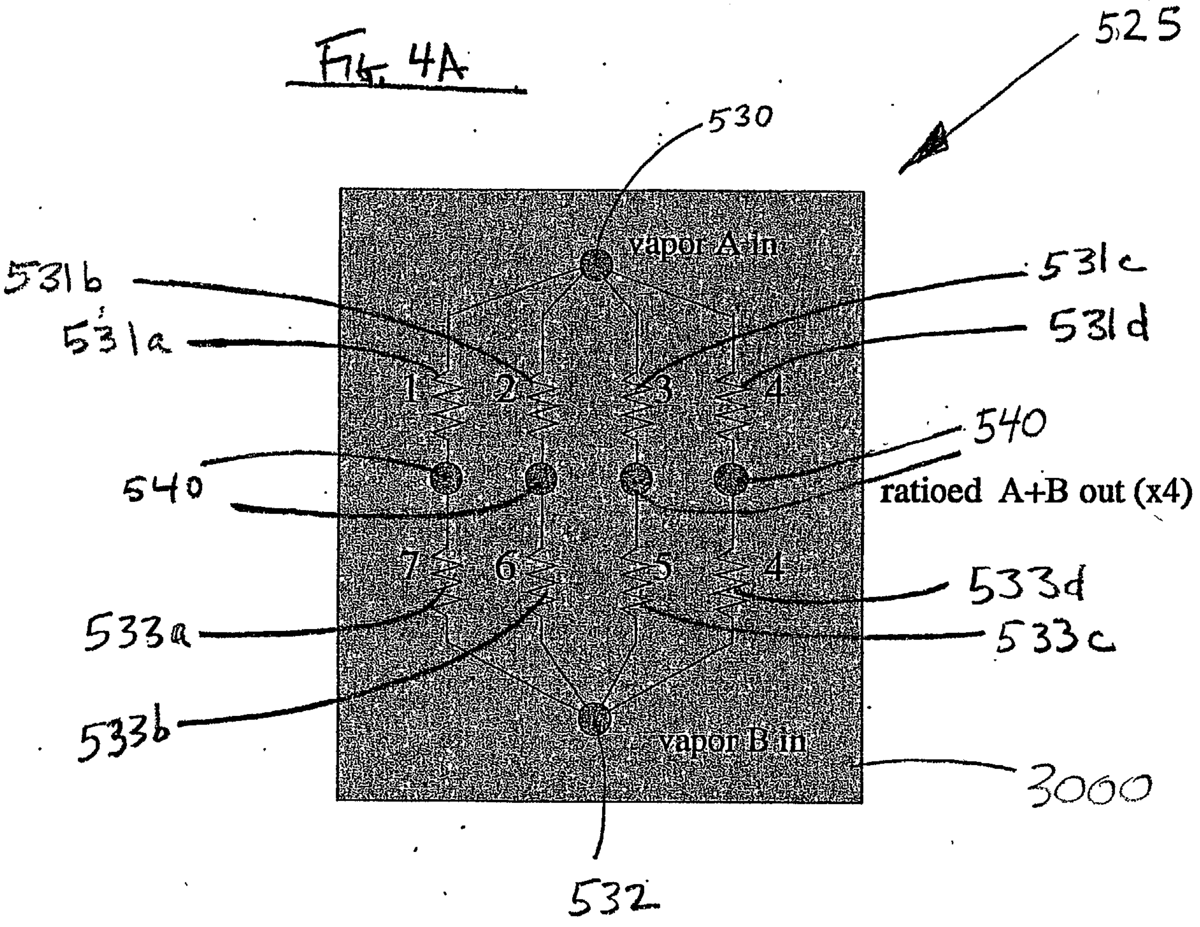

vapor A in
ratioed A+B out (x4)
vapor B in

FIG. 4B

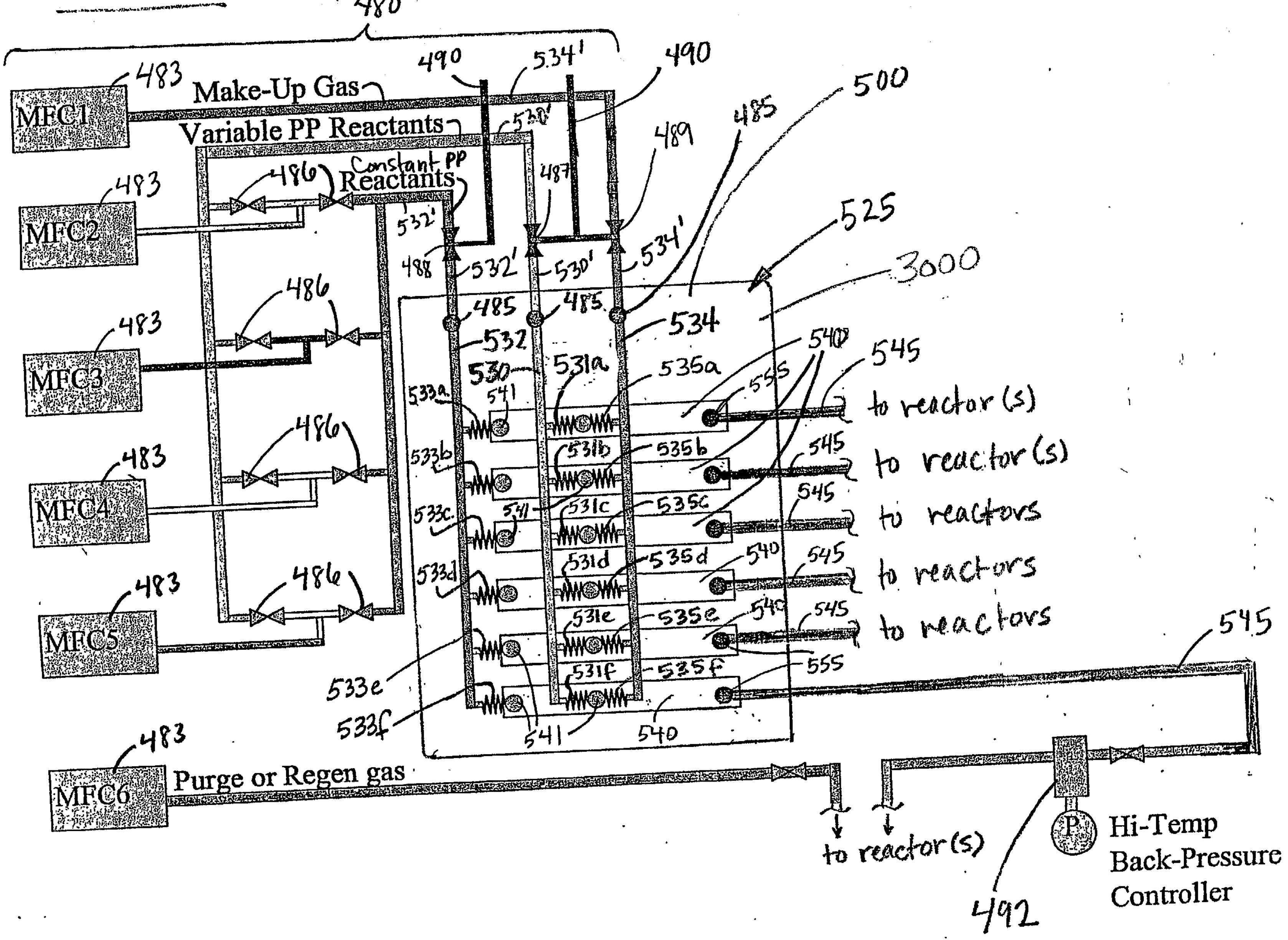

MFC1
Make-Up Gas
MFC2
Variable PP Reactants
Constant PP Reactants
MFC3
MFC4
to reactor(s)
to reactor(s)
MFC5
to reactors
to reactors
to reactors
MFC6
Purge or Regen gas
to reactor(s)
P
Hi-Temp Back-Pressure Controller

Fig. 4C

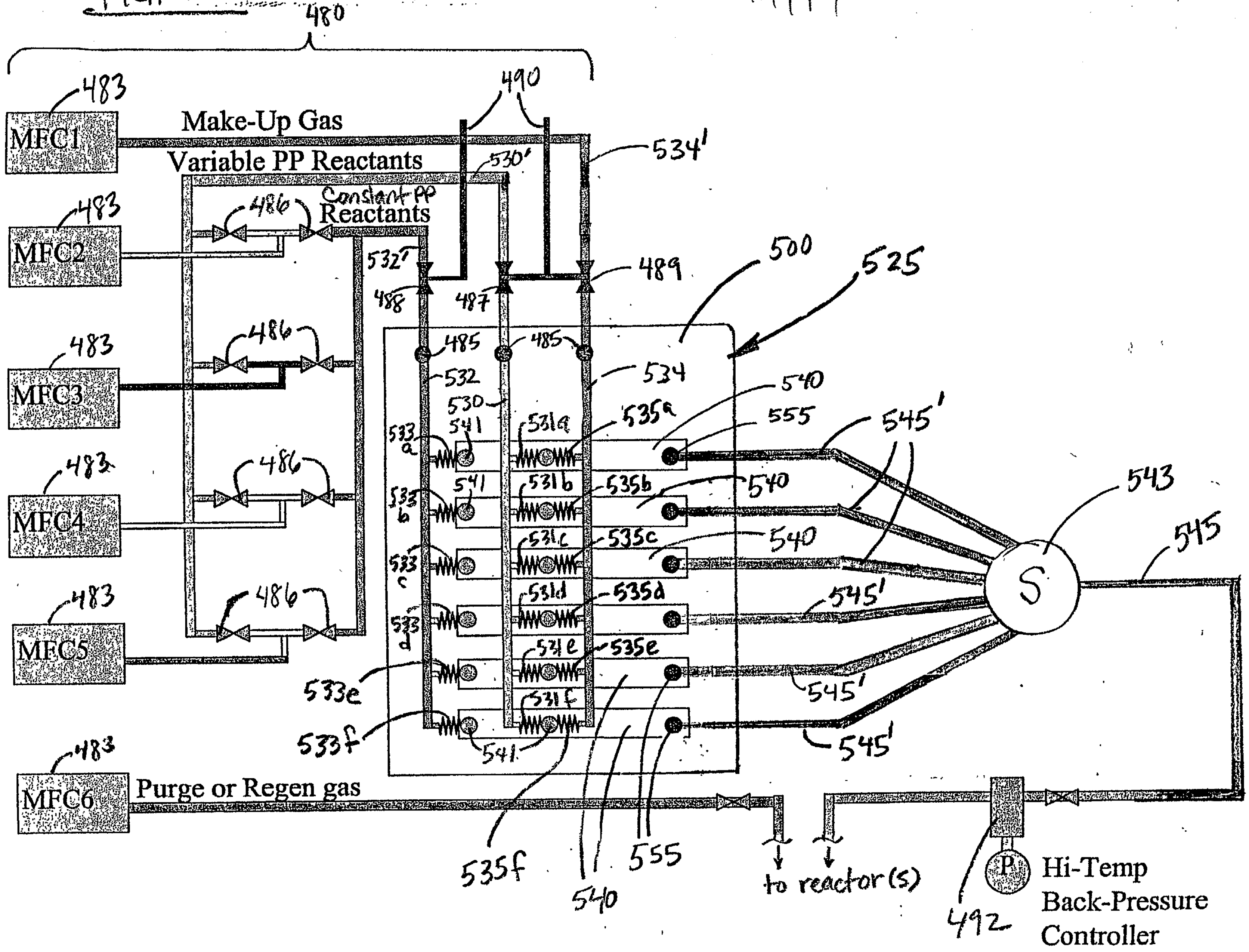

MFC1
Make-Up Gas
MFC2
Variable PP Reactants
MFC3
MFC4
MFC5
MFC6
Purge or Regen gas
Constant PP Reactants
S
to reactor(s)
P
Hi-Temp Back-Pressure Controller

FIG. 4D

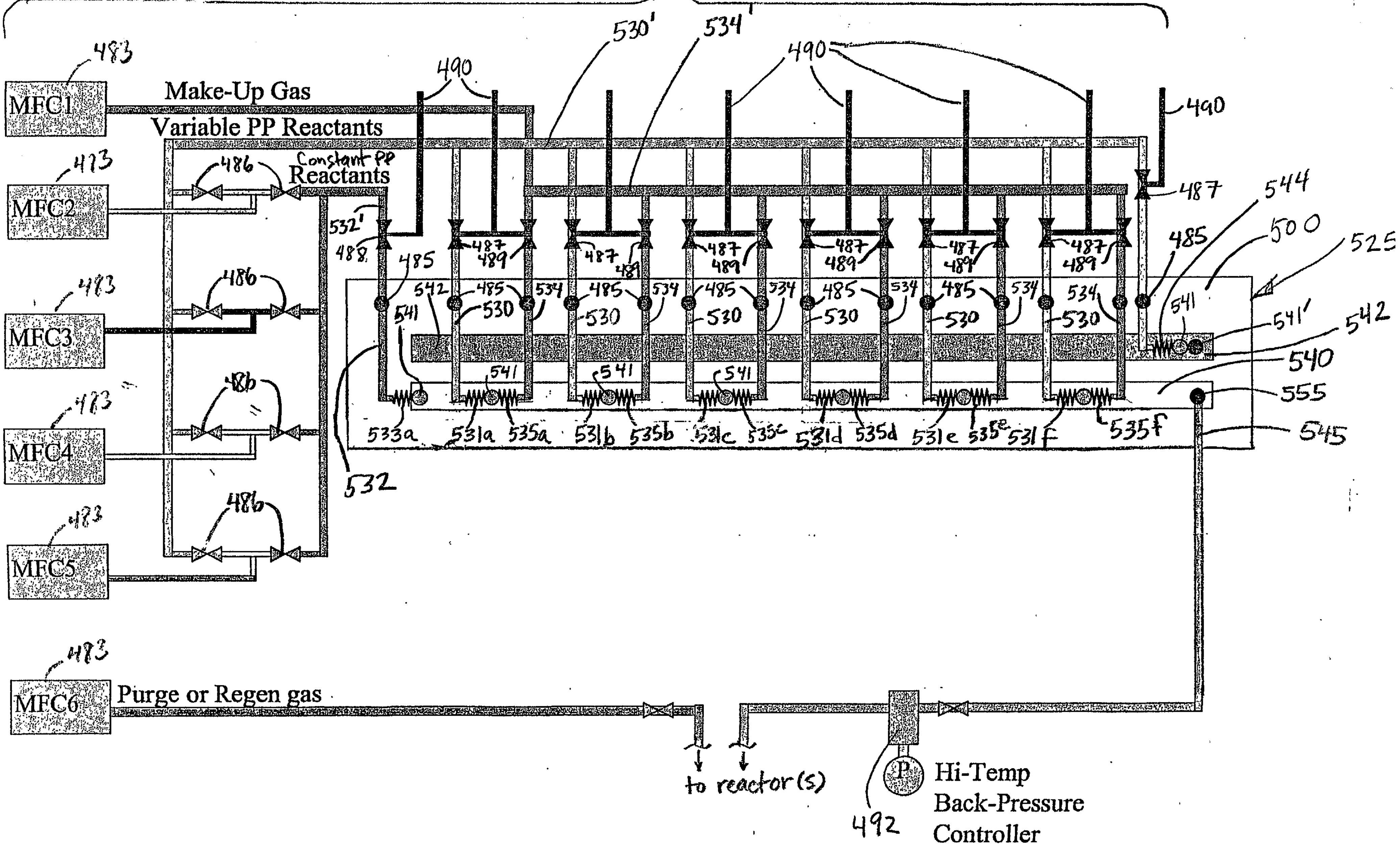

MFC1
Make-Up Gas
Variable PP Reactants
MFC2
Constant PP Reactants
MFC3
MFC4
MFC5
MFC6
Purge or Regen gas
to reactor(s)
P
Hi-Temp Back-Pressure Controller

FIG. 4E

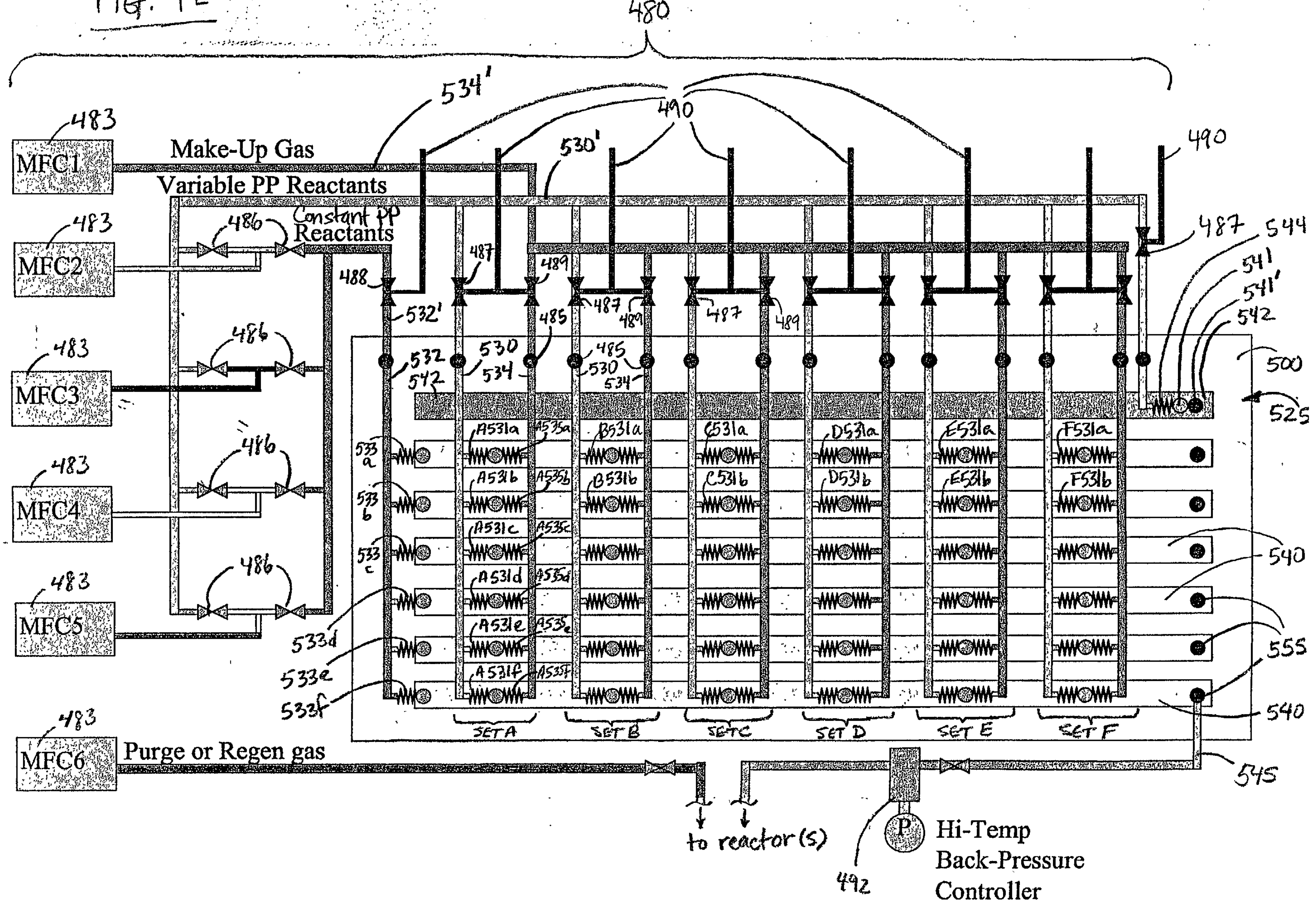

480
534'
490
530'
490
483
MFC1
Make-Up Gas
Variable PP Reactants
483
MFC2
486
Constant PP Reactants
483
MFC3
486
483
MFC4
486
483
MFC5
486
488
487
489
487
489
487
489
532'
485
532
530
542
534
485
530
534
487
544
541
541'
542
500
525
A531a
A535a
B531a
C531a
D531a
E531a
F531a
A531b
A535b
B531b
C531b
D531b
E531b
F531b
533a
533b
533c
A531c
A535c
A531d
A535d
A531e
A535e
A531f
A535f
533d
533e
533f
540
555
540
SET A
SET B
SET C
SET D
SET E
SET F
483
MFC6
Purge or Regen gas
545
to reactor(s)
492
P
Hi-Temp Back-Pressure Controller

FIG. 4F

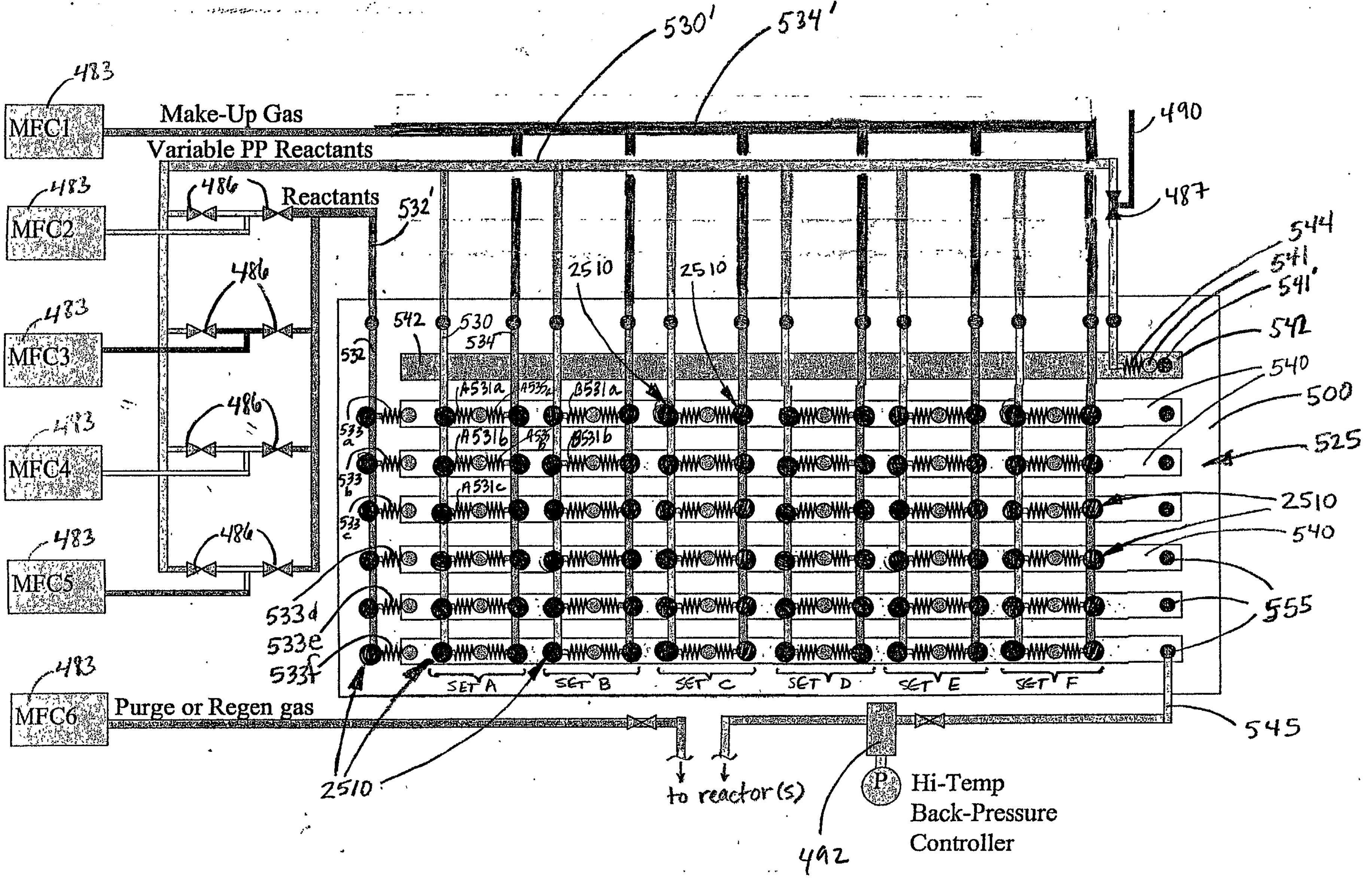

483
MFC1
483
MFC2
483
MFC3
483
MFC4
483
MFC5
483
MFC6
Make-Up Gas
Variable PP Reactants
Reactants
486
486
486
486
530'
534'
532'
490
487
544
541
541'
542
542
530
534
532
540
500
525
2510
2510
2510
2510
540
555
A531a
A535a
B531a
A531b
A53B
B531b
A531c
533a
533b
533c
533d
533e
533f
SET A
SET B
SET C
SET D
SET E
SET F
545
Purge or Regen gas
to reactor(s)
492
P
Hi-Temp
Back-Pressure
Controller

FIG. 5A

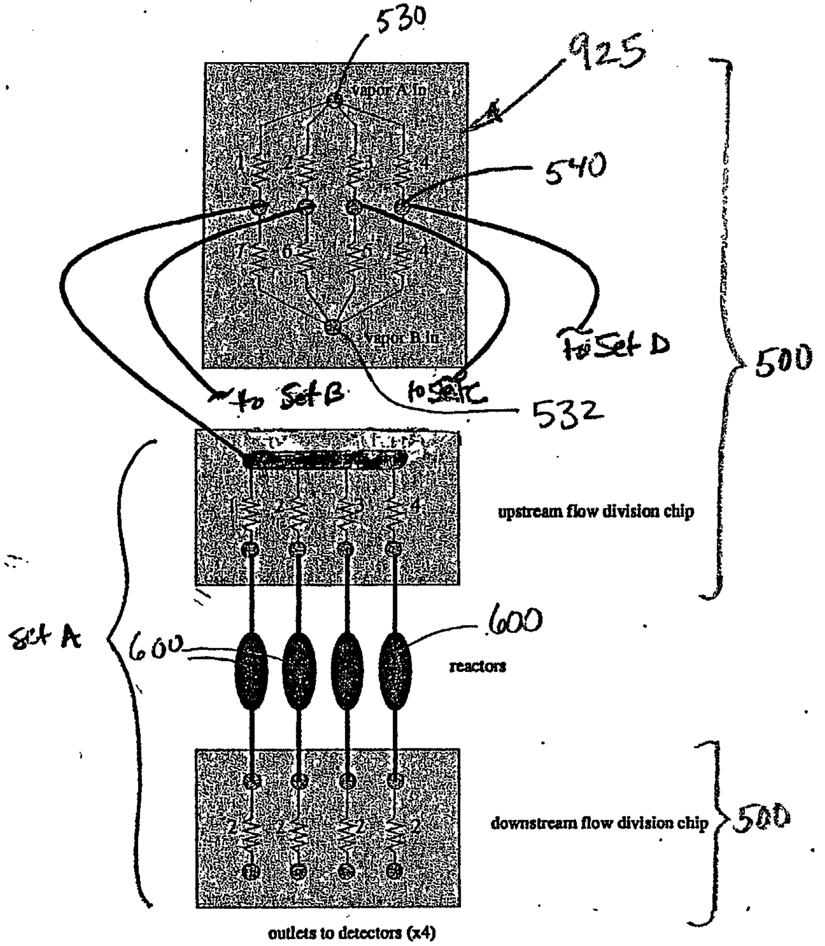

vapor A in
vapor B in
to Set B
to Set C
to Set D
upstream flow division chip
Set A
reactors
downstream flow division chip
outlets to detectors (x4)

FIG. 5B

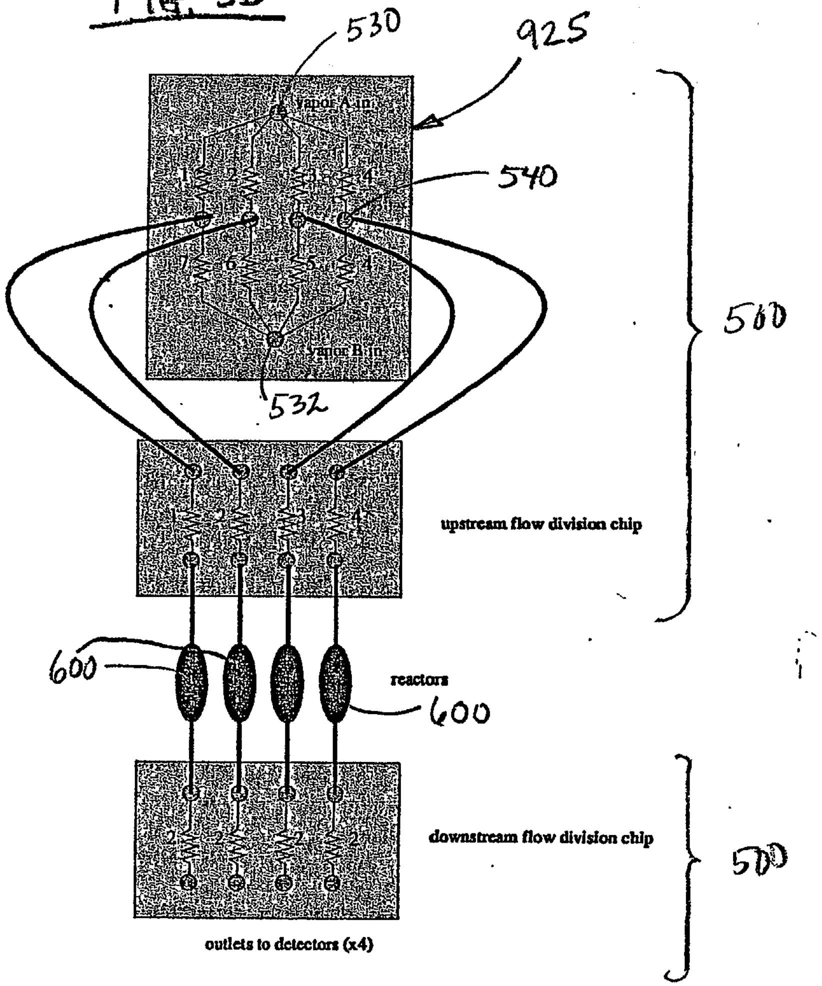

vapor A in
vapor B in
upstream flow division chip
reactors
downstream flow division chip
outlets to detectors (x4)

FIG. 5C

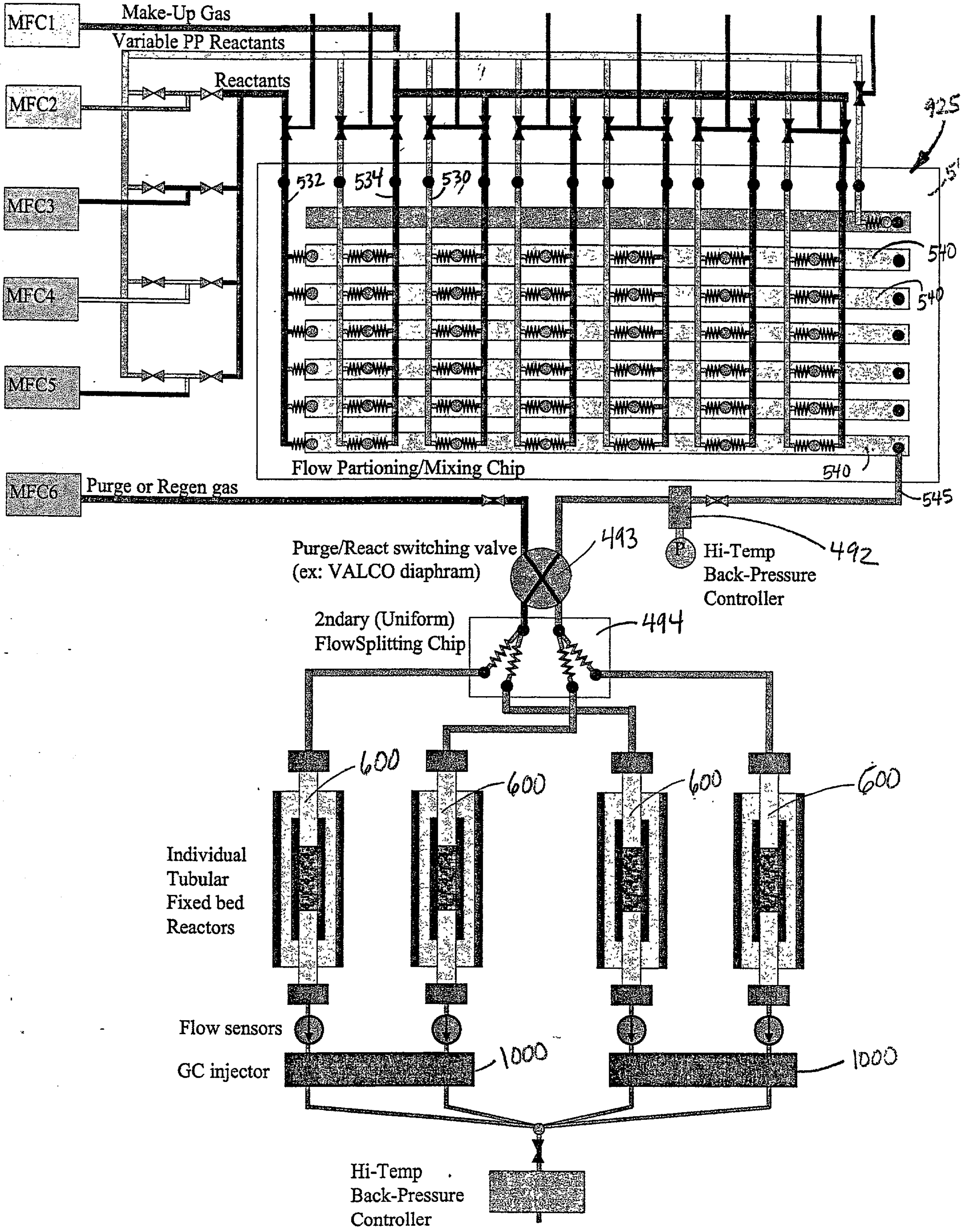

MFC1
Make-Up Gas
Variable PP Reactants
MFC2
Reactants
MFC3
MFC4
MFC5
925
51
532
534
530
540
540
540
Flow Partioning/Mixing Chip
MFC6
Purge or Regen gas
545
Purge/React switching valve (ex: VALCO diaphram)
493
P
Hi-Temp Back-Pressure Controller
492
2ndary (Uniform) FlowSplitting Chip
494
600
600
600
600
Individual Tubular Fixed bed Reactors
Flow sensors
GC injector
1000
1000
Hi-Temp Back-Pressure Controller

FIG. 6A

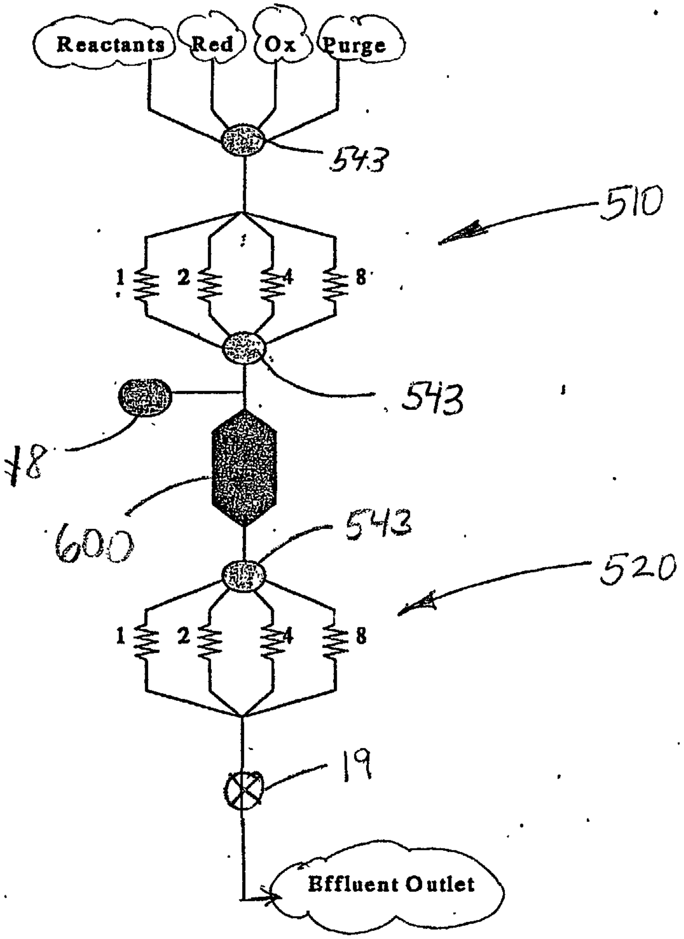

Reactants
Red
Ox
Purge
Effluent Outlet

Fig. 7A

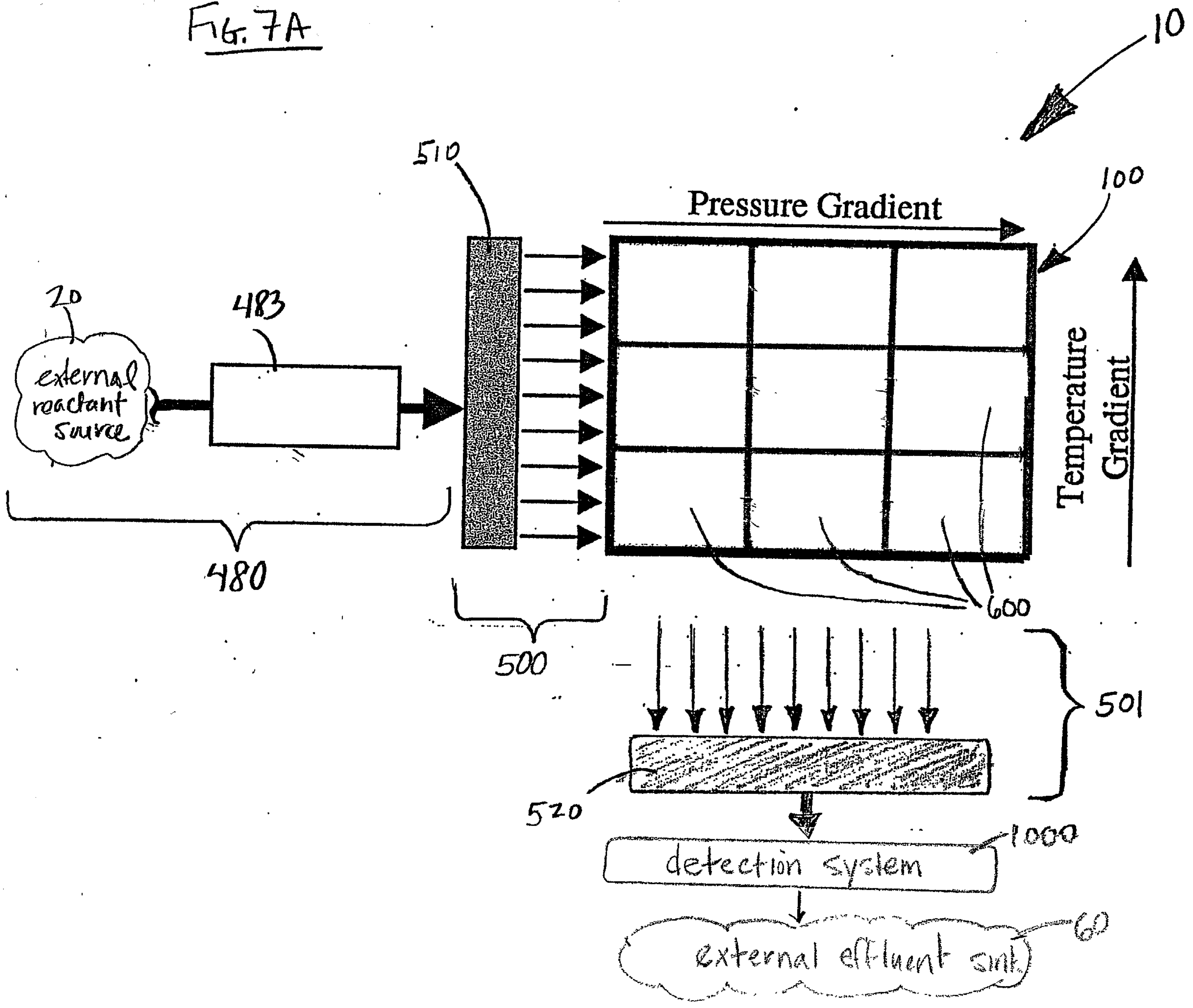

Pressure Gradient
external reactant source
Temperature Gradient
detection system
external effluent sink

FIG. 7B

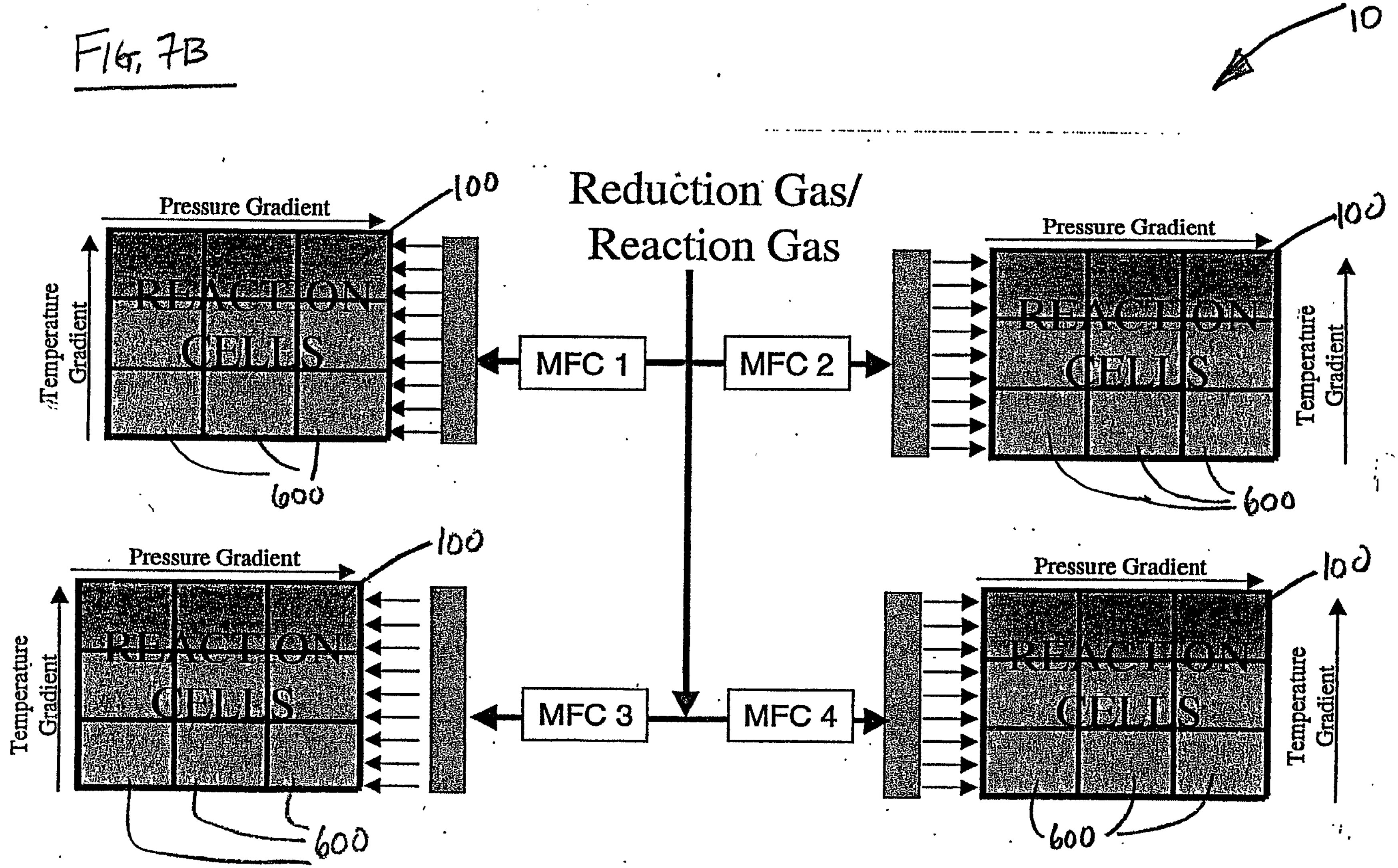

10
Reduction Gas/
Reaction Gas
MFC 1
MFC 2
MFC 3
MFC 4
Pressure Gradient
Temperature Gradient
REACTION CELLS
100
600

Fig. 7C

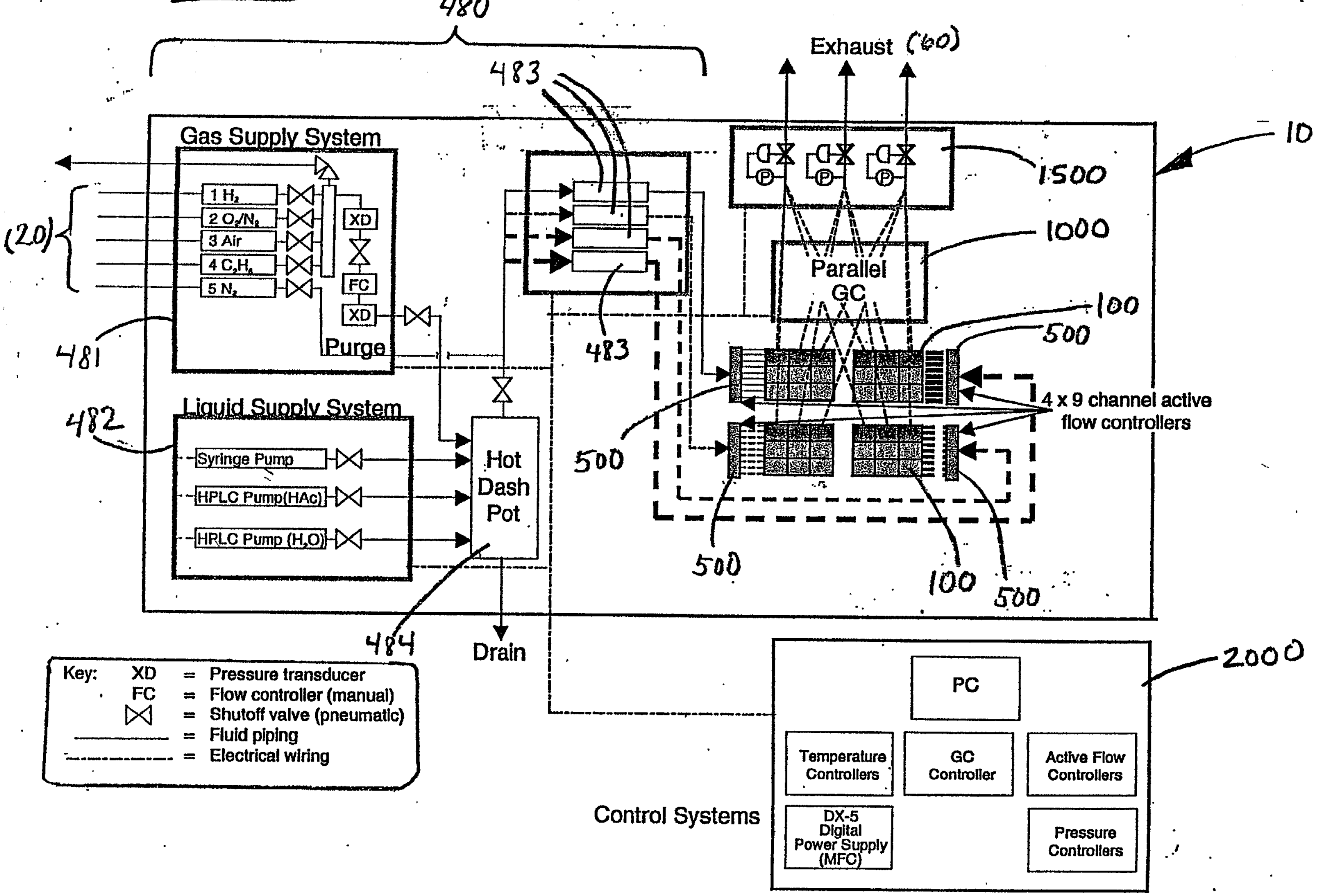
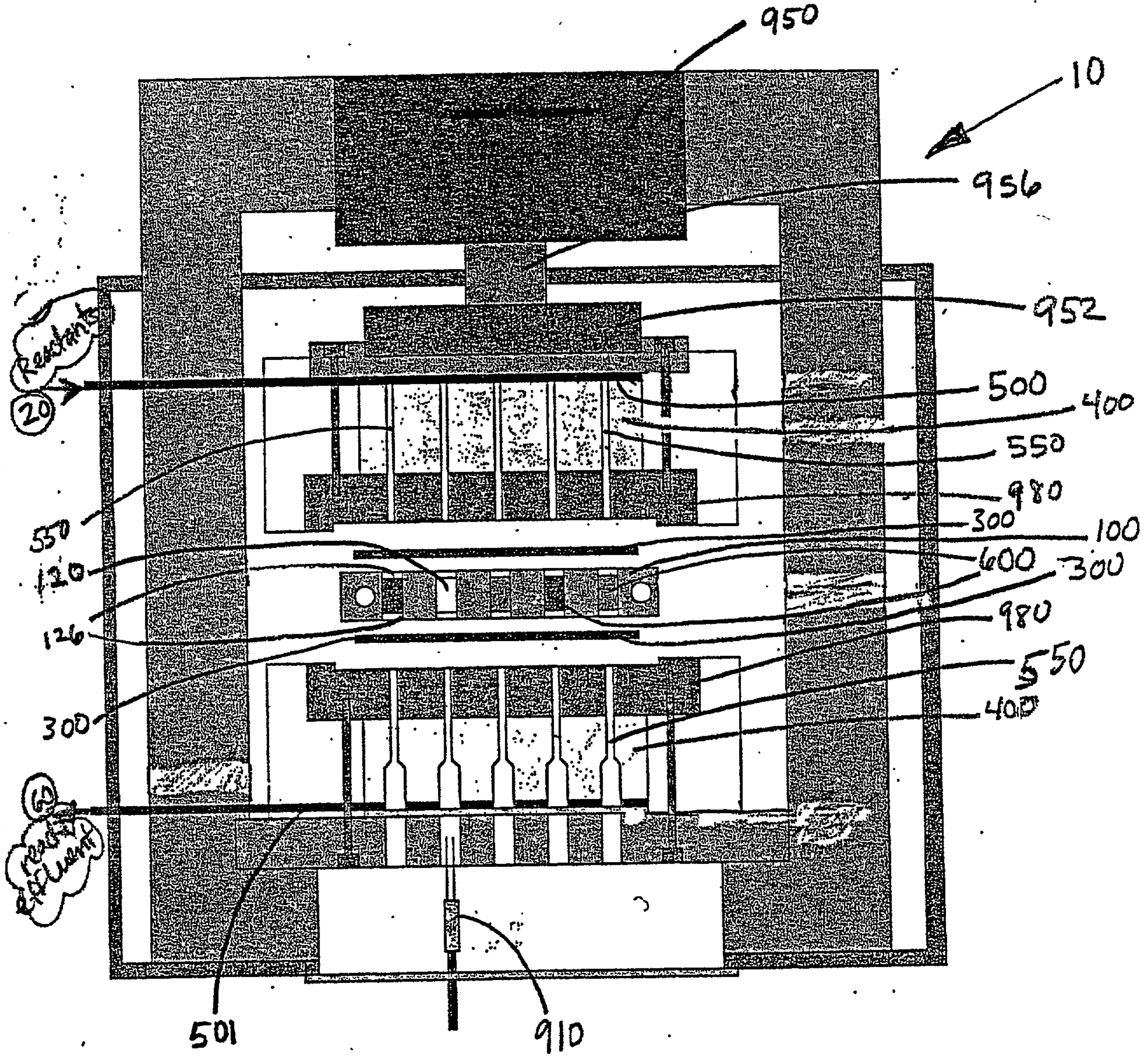

480
483
Exhaust (60)
10
Gas Supply System
1 H_2
2 O_2/N_2
3 Air
4 C_2H_4
5 N_2
XD
FC
XD
Purge
(20)
481
1500
1000
Parallel GC
100
500
483
4 x 9 channel active flow controllers
Liquid Supply System
482
Syringe Pump
HPLC Pump(HAc)
HPLC Pump (H_2O)
Hot Dash Pot
500
500
100
500
484
Drain
2000
Key:
XD = Pressure transducer
FC = Flow controller (manual)
⋈ = Shutoff valve (pneumatic)
= Fluid piping
= Electrical wiring
PC
Temperature Controllers
GC Controller
Active Flow Controllers
DX-5 Digital Power Supply (MFC)
Pressure Controllers
Control Systems

FIG. 8A


Reactants
reactor effluent

28|47

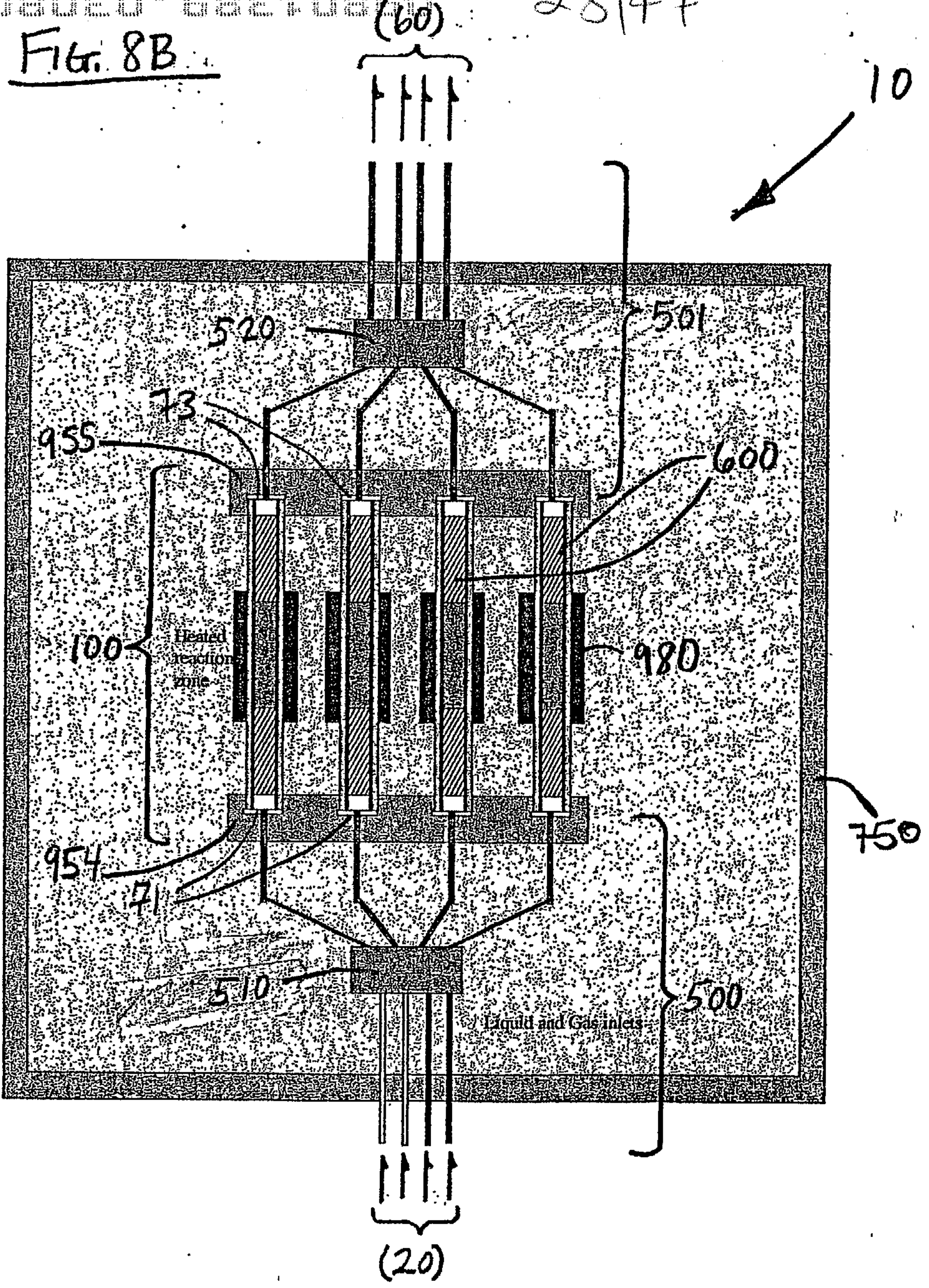

(60)
Heated reaction zone
Liquid and Gas inlets
(20)

Fig. 8B

FIG. 8C

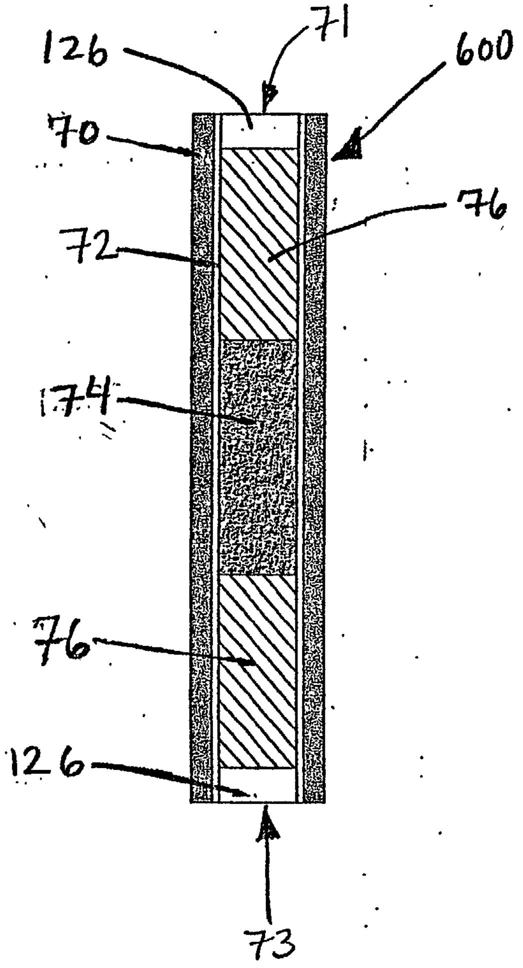

126
71
600
70
76
72
174
76
126
73

FIG. 8D

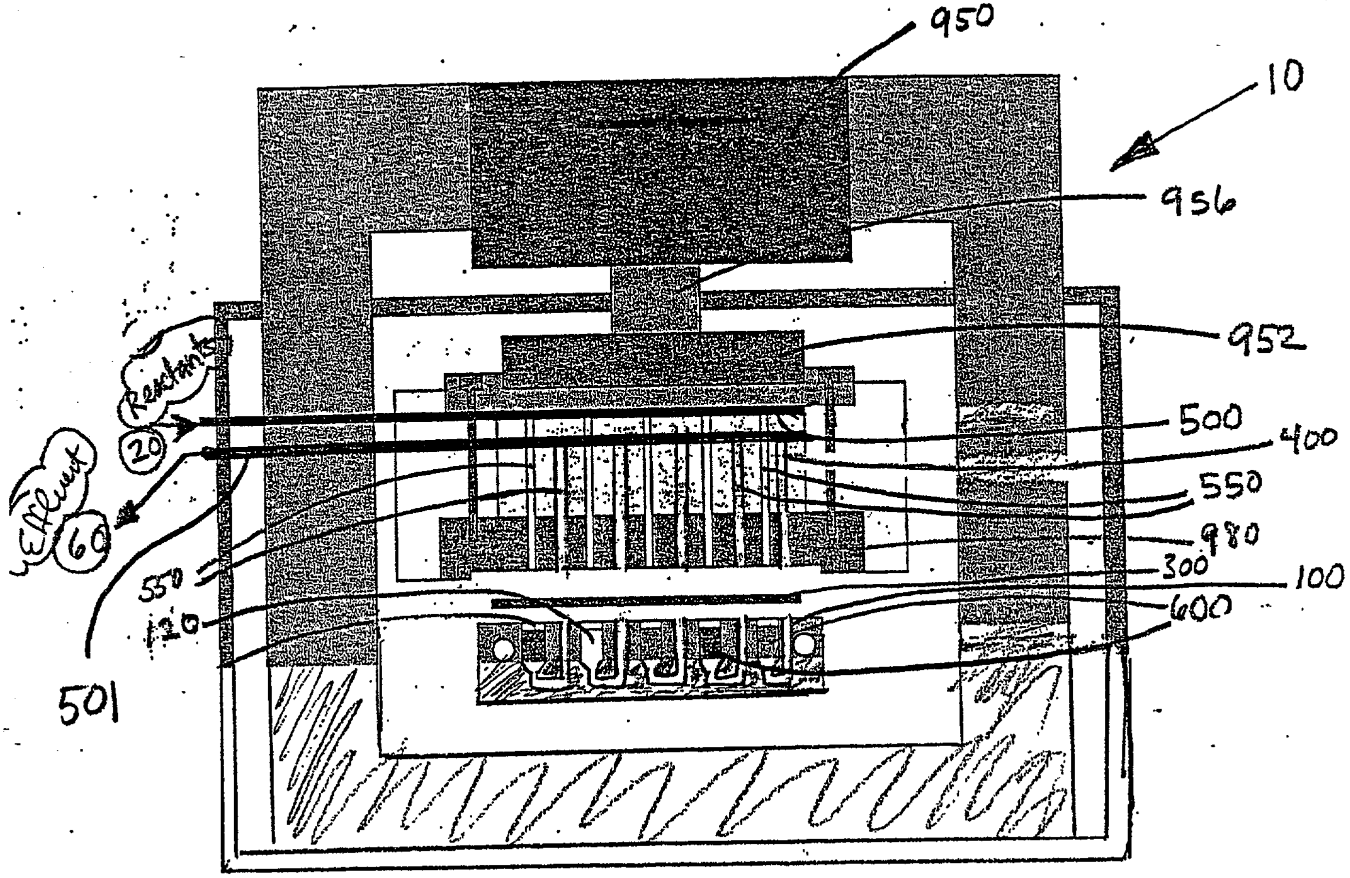

Reactants
Effluent

FIG. 8E

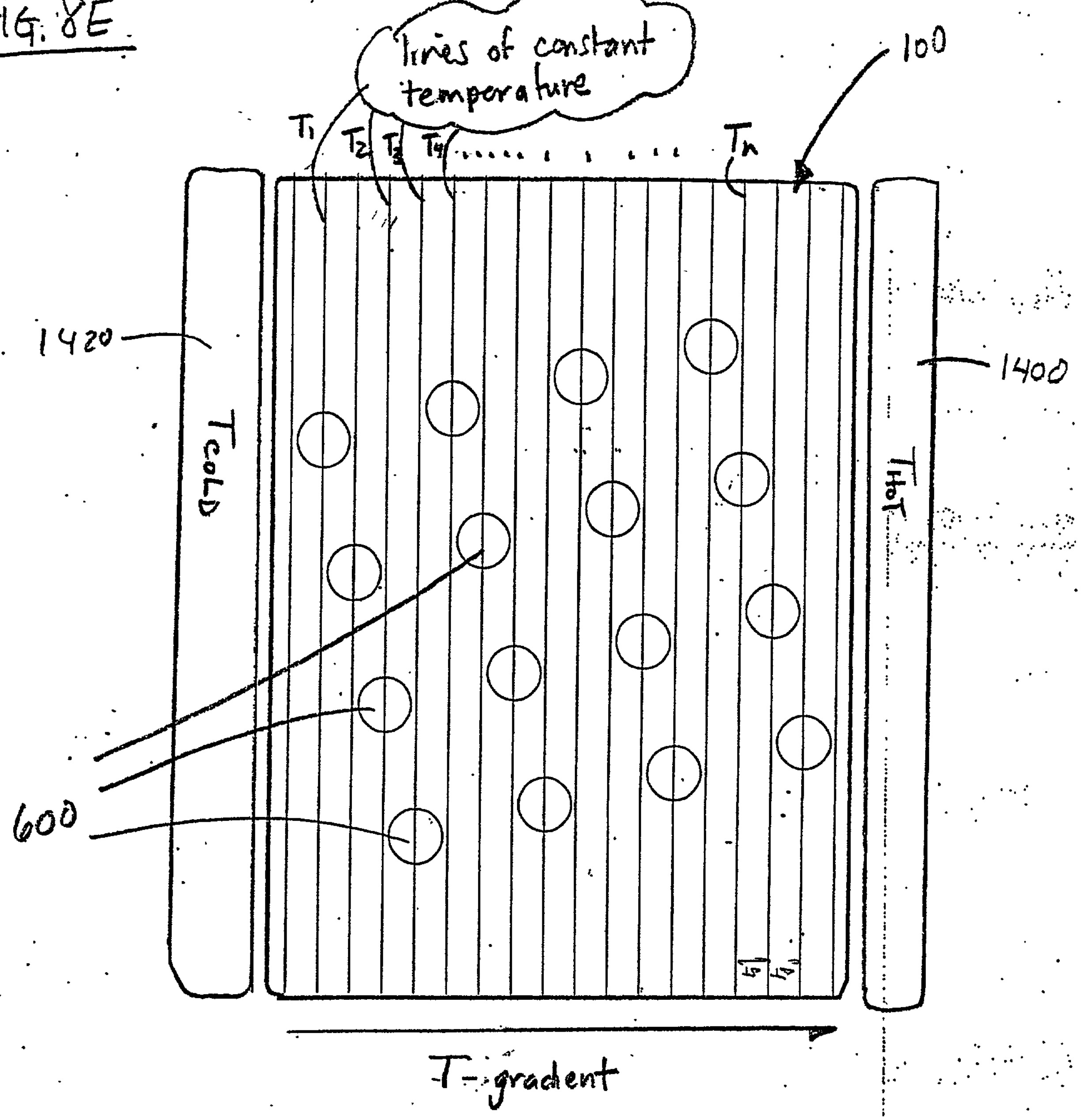

lines of constant temperature
T1
T2
T3
T4
Tn
100
1420
TCOLD
1400
THOT
600
T-gradient

FIG. 9A

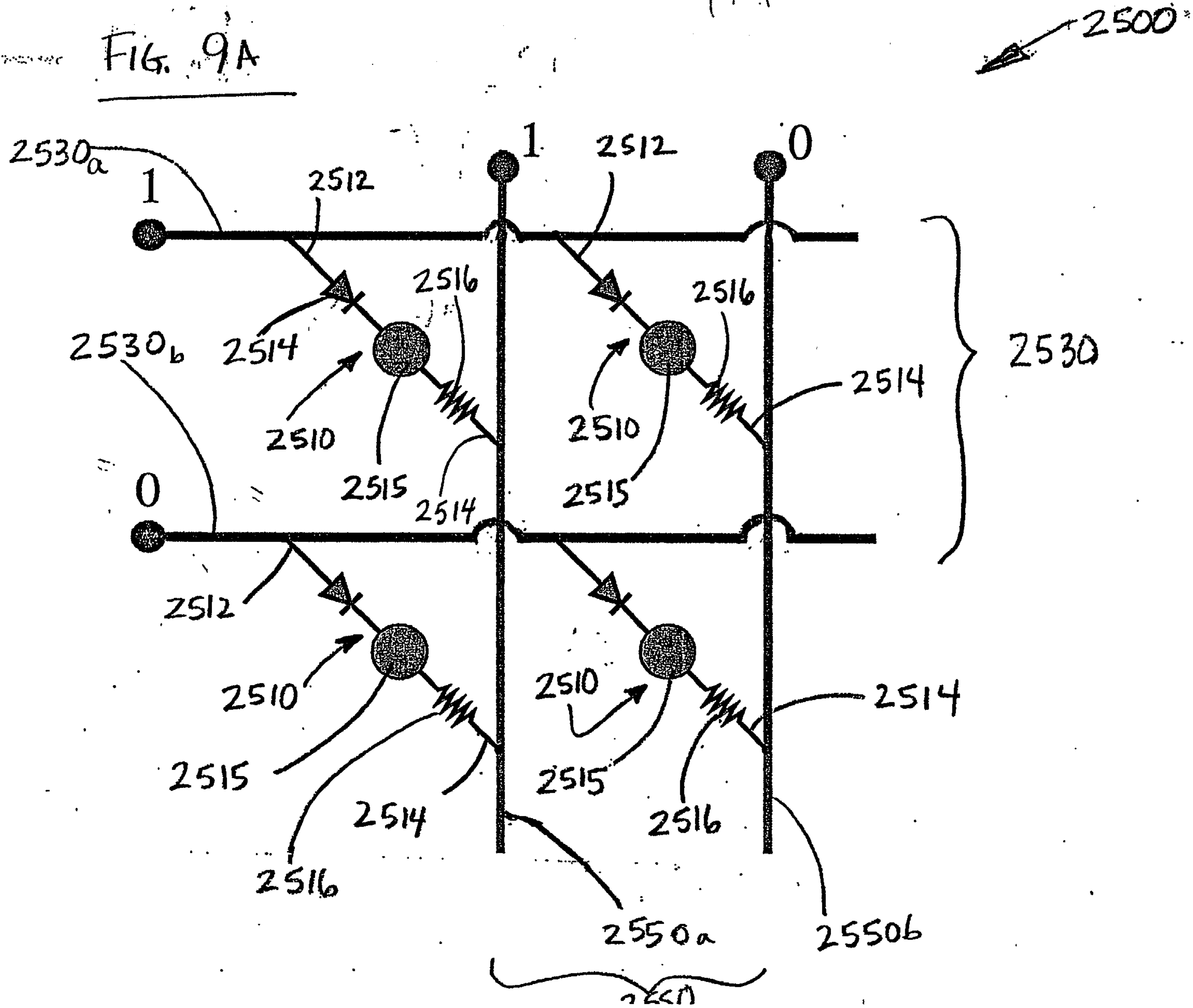


Fig. 9B

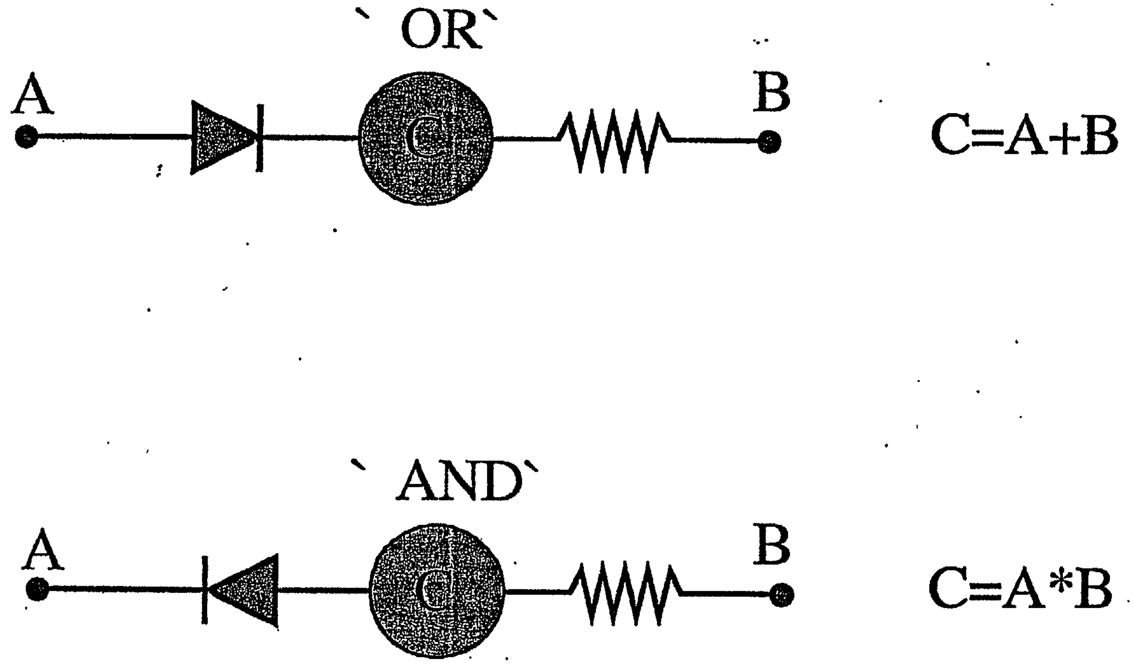
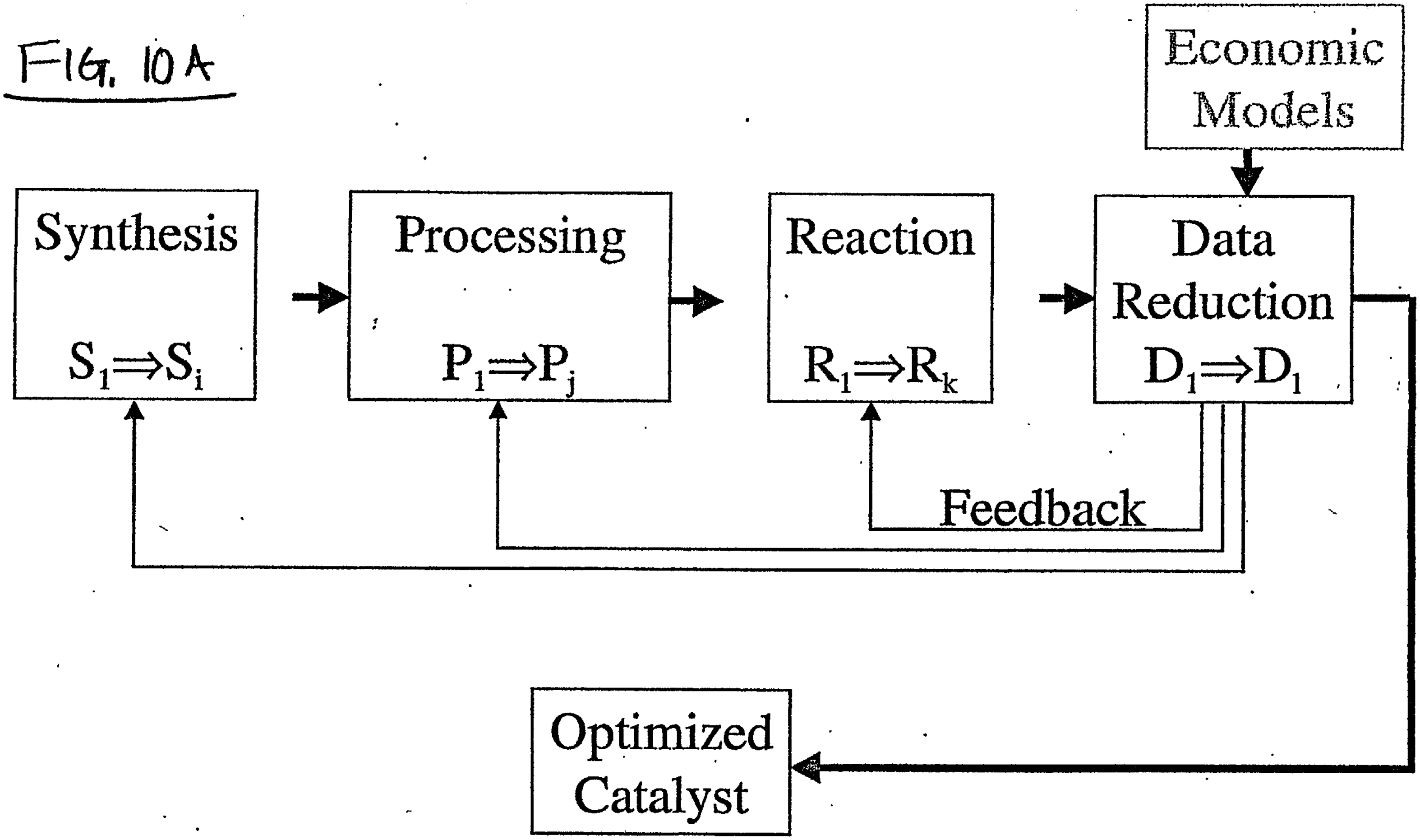
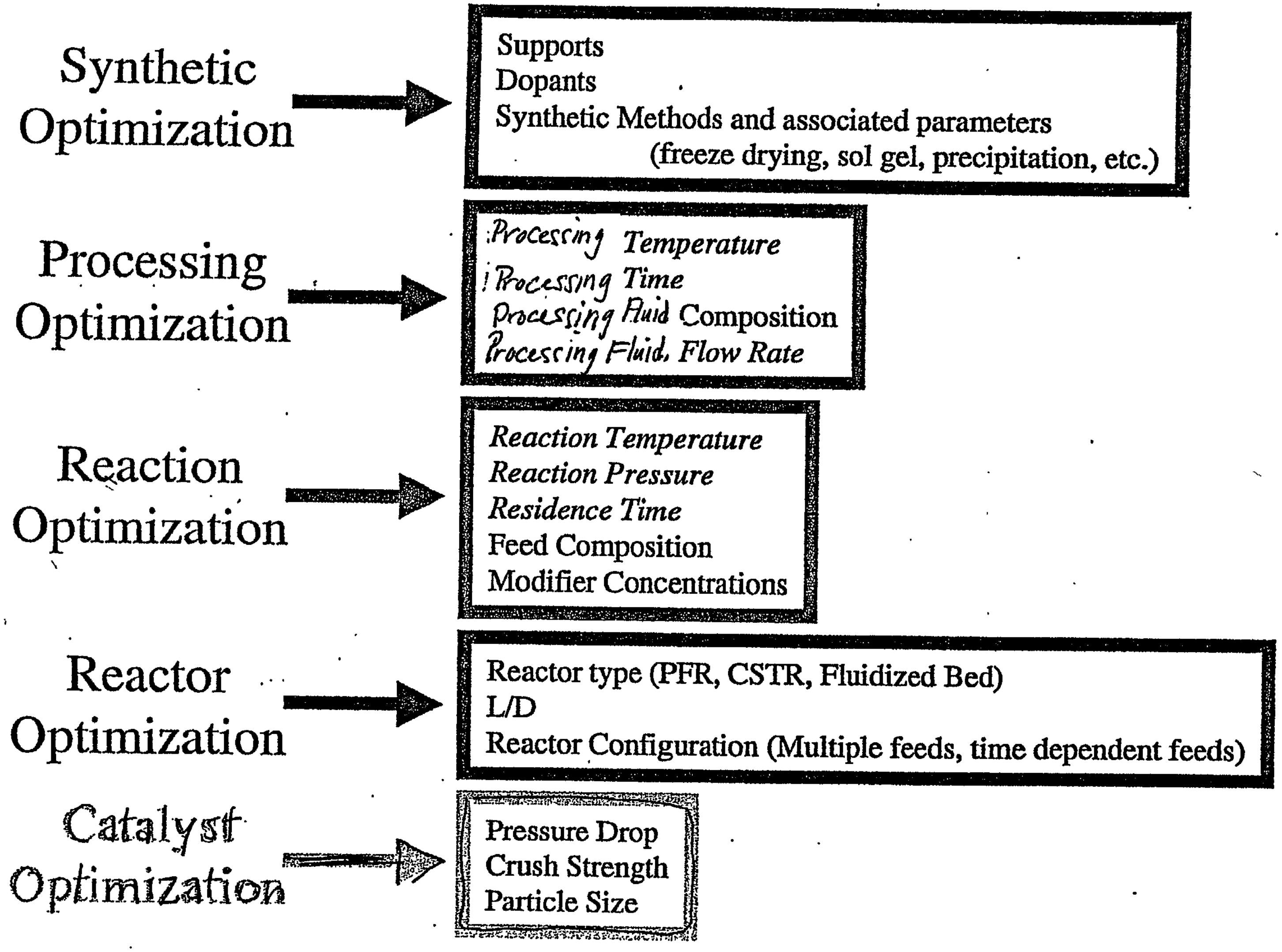

` OR`
A
C
B
C=A+B
` AND`
A
C
B
C=A*B

FIG. 10A


Economic Models
Synthesis
$S_1 \Rightarrow S_i$
Processing
$P_1 \Rightarrow P_j$
Reaction
$R_1 \Rightarrow R_k$
Data Reduction
$D_1 \Rightarrow D_l$
Feedback
Optimized Catalyst

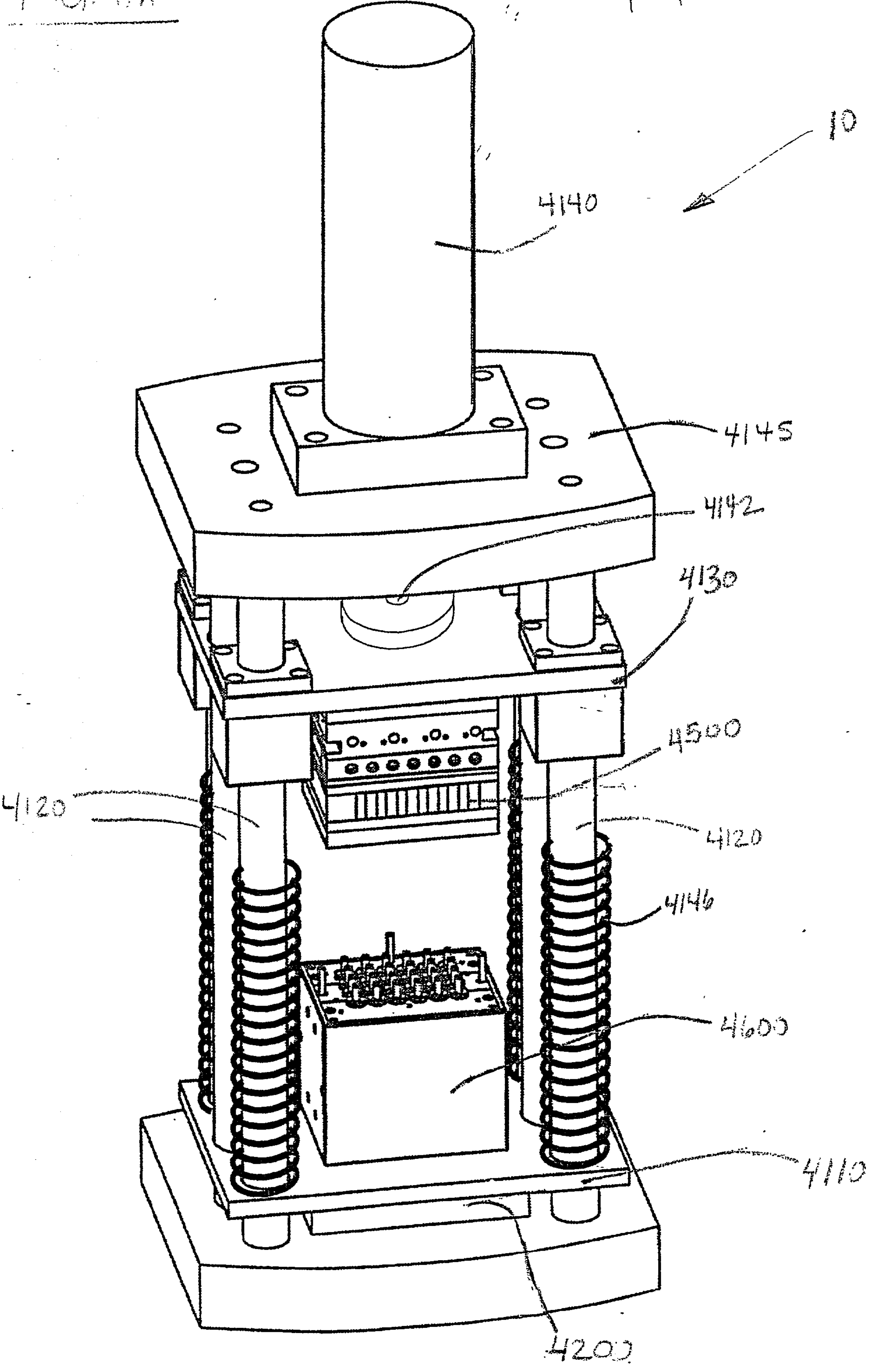
2000-022

FIG. 10B


Synthetic Optimization
Supports
Dopants
Synthetic Methods and associated parameters
(freeze drying, sol gel, precipitation, etc.)
Processing Optimization
Processing Temperature
Processing Time
Processing Fluid Composition
Processing Fluid, Flow Rate
Reaction Optimization
Reaction Temperature
Reaction Pressure
Residence Time
Feed Composition
Modifier Concentrations
Reactor Optimization
Reactor type (PFR, CSTR, Fluidized Bed)
L/D
Reactor Configuration (Multiple feeds, time dependent feeds)
Catalyst Optimization
Pressure Drop
Crush Strength
Particle Size

2000-022

FIG. 11A


10
4140
4145
4142
4130
4500
4120
4120
4146
4600
4110
4200

09801389.030801

FIG. 11B

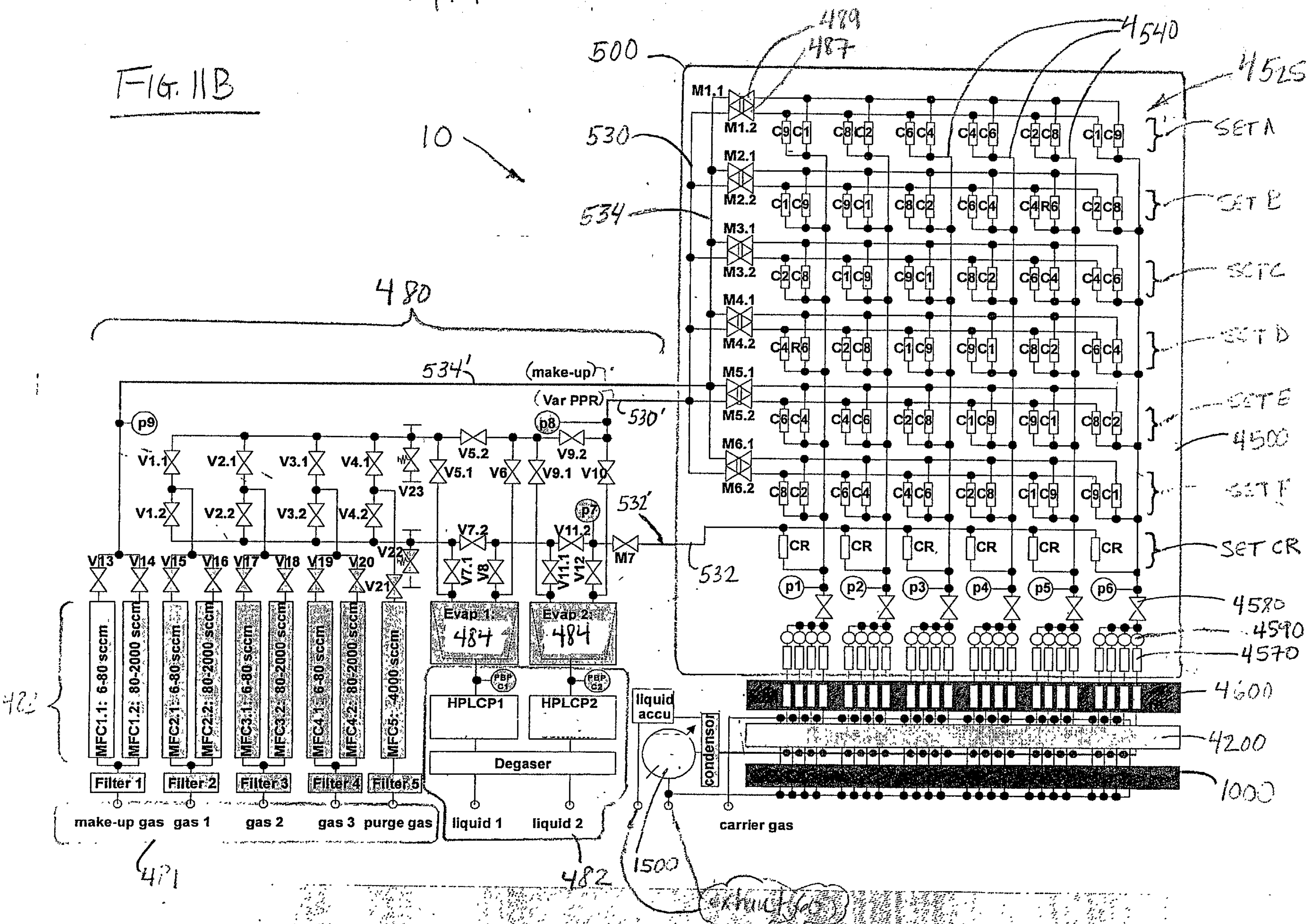

10
500
530
534
489
487
4540
4525
M1.1
M1.2
M2.1
M2.2
M3.1
M3.2
M4.1
M4.2
M5.1
M5.2
M6.1
M6.2
M7
C9 C1
C8 C2
C6 C4
C4 C6
C2 C8
C1 C9
C9 C1
C8 C2
C6 C4
C4 R6
C1 C9
C4 R6
SET A
SET B
SET C
SET D
SET E
SET F
SET CR
4500
CR
p1
p2
p3
p4
p5
p6
p7
p8
p9
4580
4590
4570
4600
4200
1000
480
534'
(make-up)'
(Var PPR)
530'
532'
532
V1.1
V1.2
V2.1
V2.2
V3.1
V3.2
V4.1
V4.2
V5.1
V5.2
V6
V7.1
V7.2
V8
V9.1
V9.2
V10
V11.1
V11.2
V12
V13
V14
V15
V16
V17
V18
V19
V20
V21
V22
V23
MFC1.1: 6-80 sccm
MFC1.2: 80-2000 sccm
MFC2.1: 6-80 sccm
MFC2.2: 80-2000 sccm
MFC3.1: 6-80 sccm
MFC3.2: 80-2000 sccm
MFC4.1: 6-80 sccm
MFC4.2: 80-2000 sccm
MFC5: 4000 sccm
Filter 1
Filter 2
Filter 3
Filter 4
Filter 5
make-up gas
gas 1
gas 2
gas 3
purge gas
482
481
Evap 1
Evap 2
484
PBP C1
PBP C2
HPLCP1
HPLCP2
Degaser
liquid 1
liquid 2
482
liquid accu
condensor
carrier gas
1500
exhaust(66)

Fig. 11C

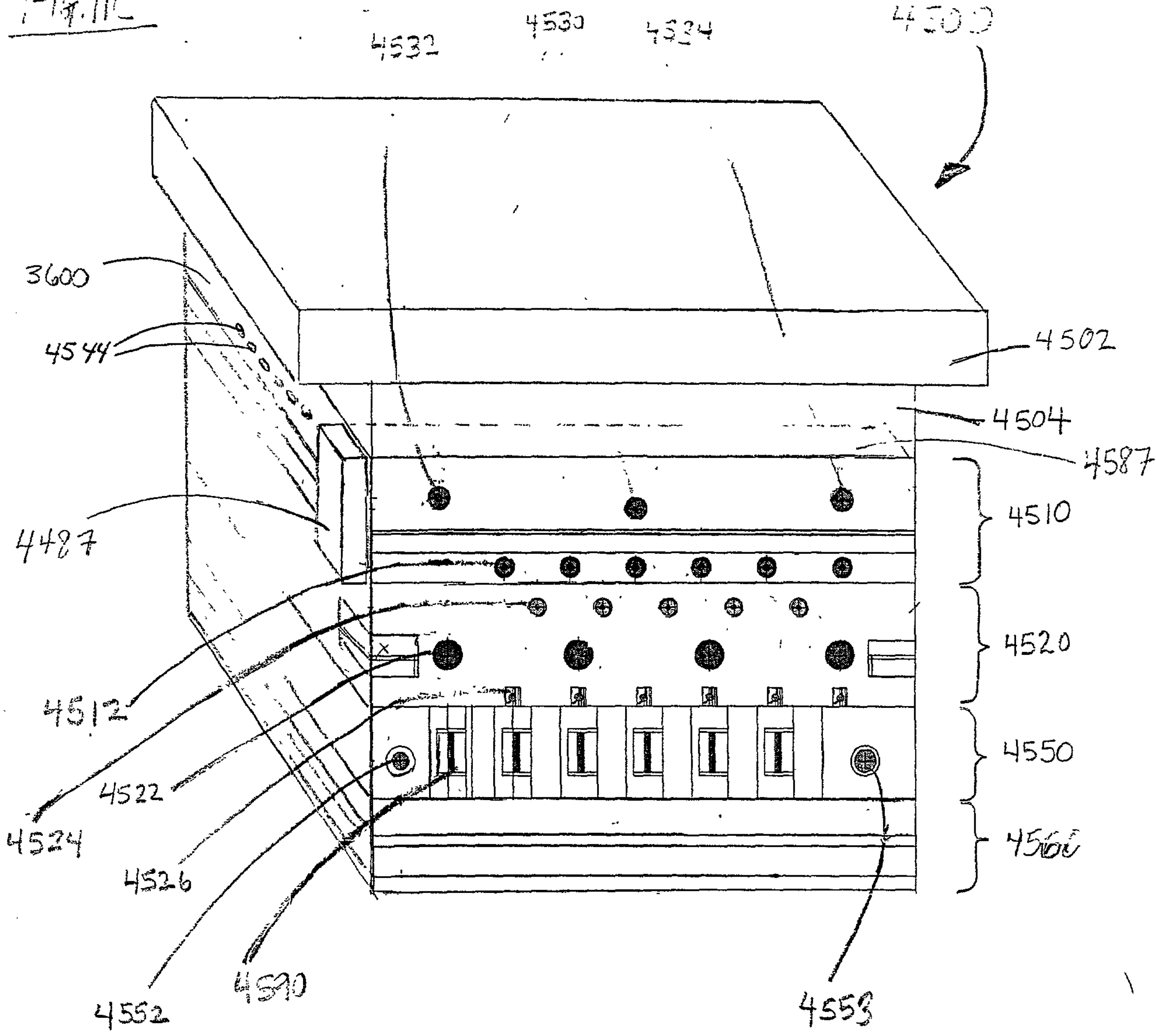


FIG. 11D

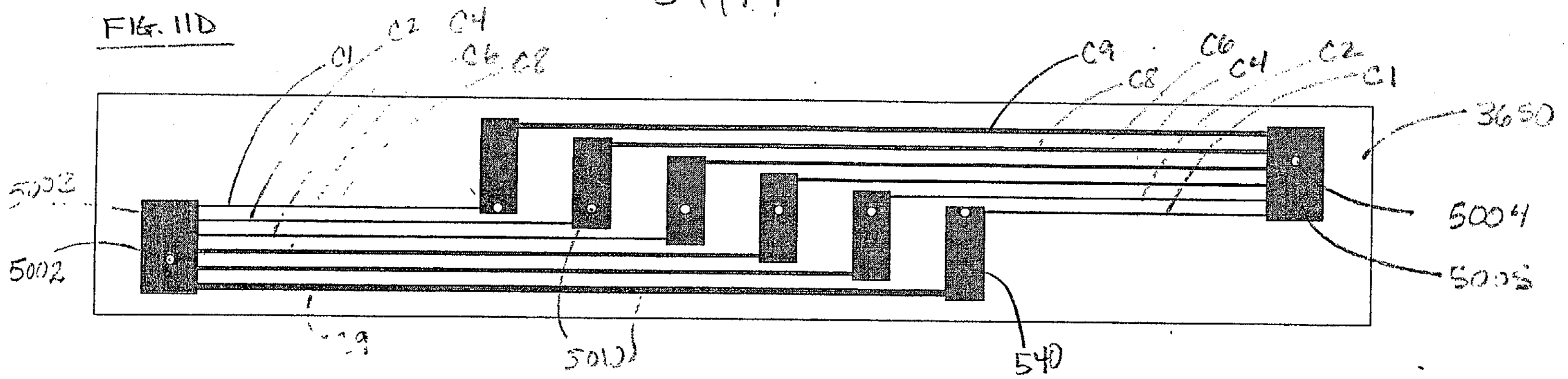

C1
C2
C4
C6
C8
C9
C8
C6
C4
C2
C1
3650
5004
5005
5003
5002
C9
5010
540

FIG 11E

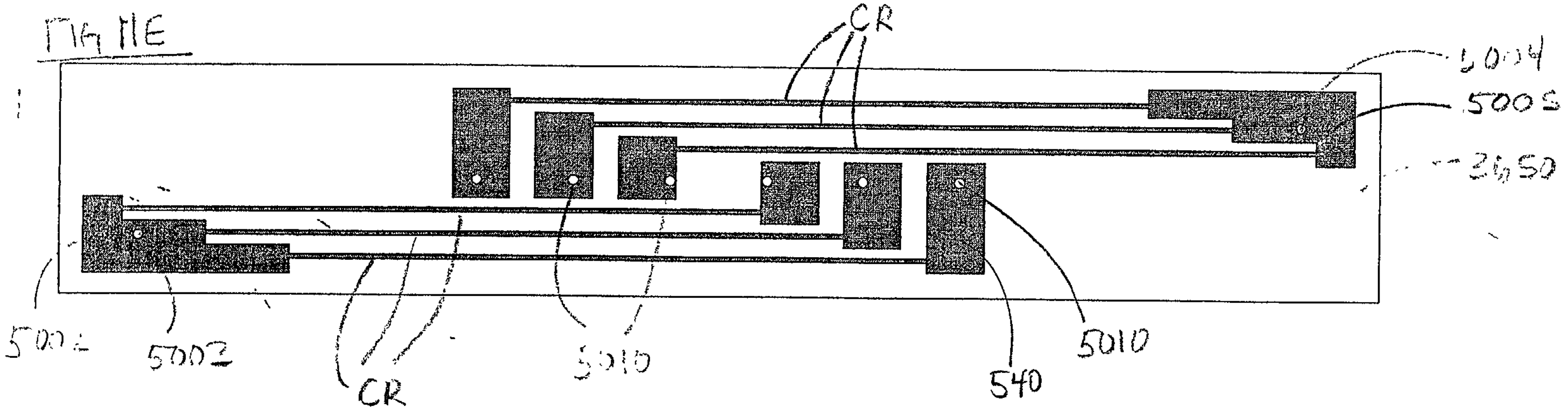

CR
5004
5005
3650
5002
5002
CR
5010
540
5010

FIG 11F

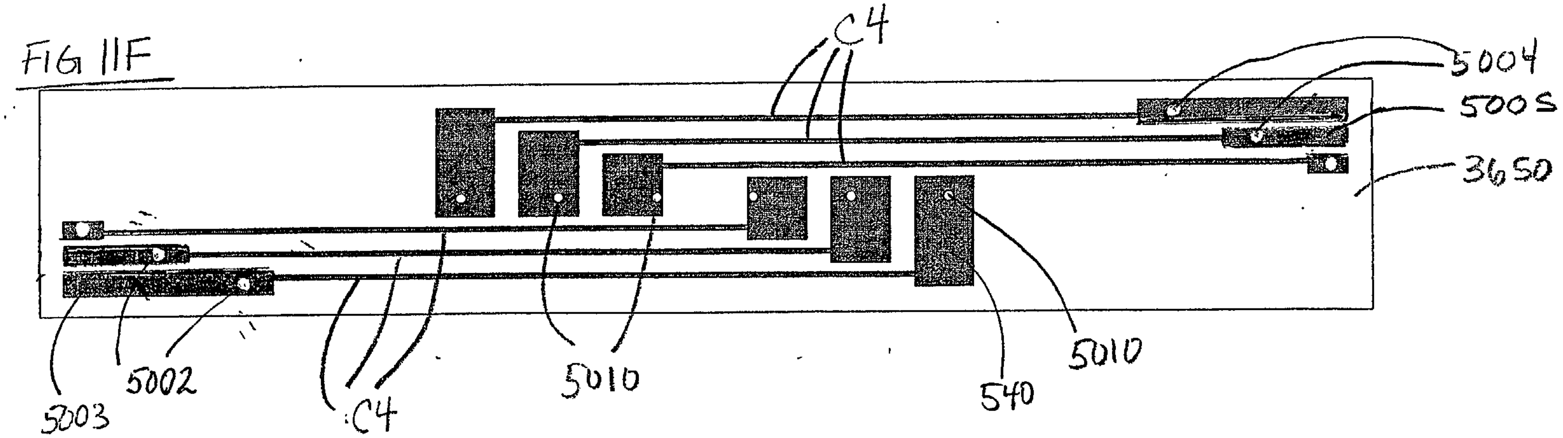

C4
5004
5005
3650
5003
5002
C4
5010
540
5010

FIG. 11G

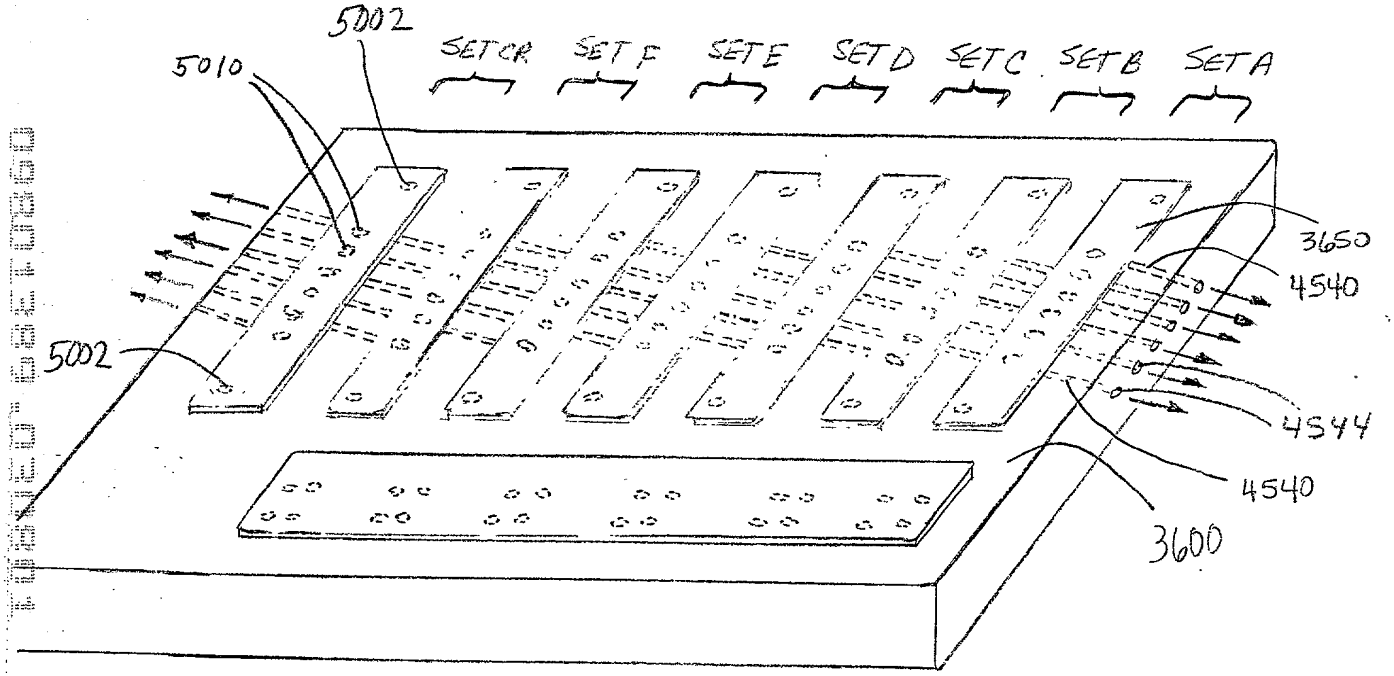

5002
SET CR
SET F
SET E
SET D
SET C
SET B
SET A
5010
3650
4540
5002
4544
4540
3600

FIG. 11H

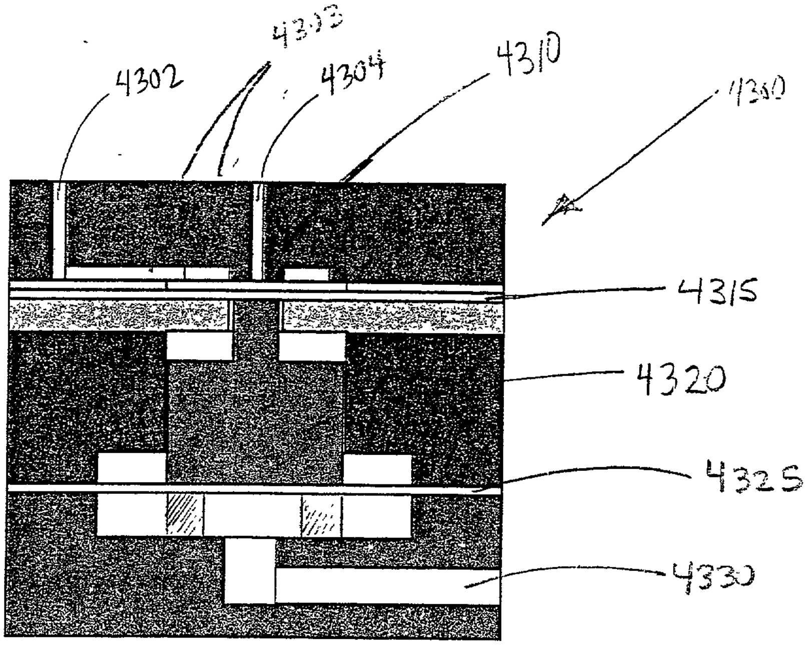

4303
4302
4304
4310
4300
4315
4320
4325
4330

FIG 11I

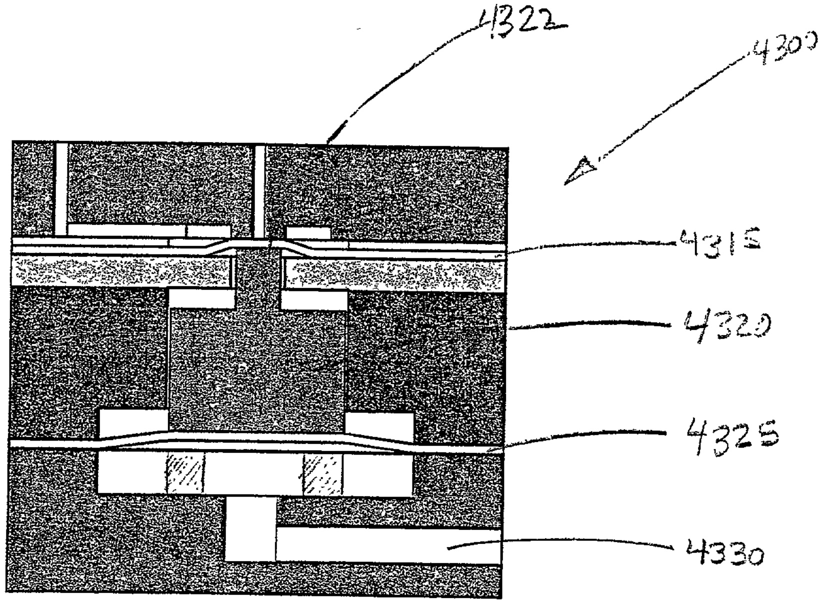

4322
4300
4315
4320
4325
4330

FIG. 11J

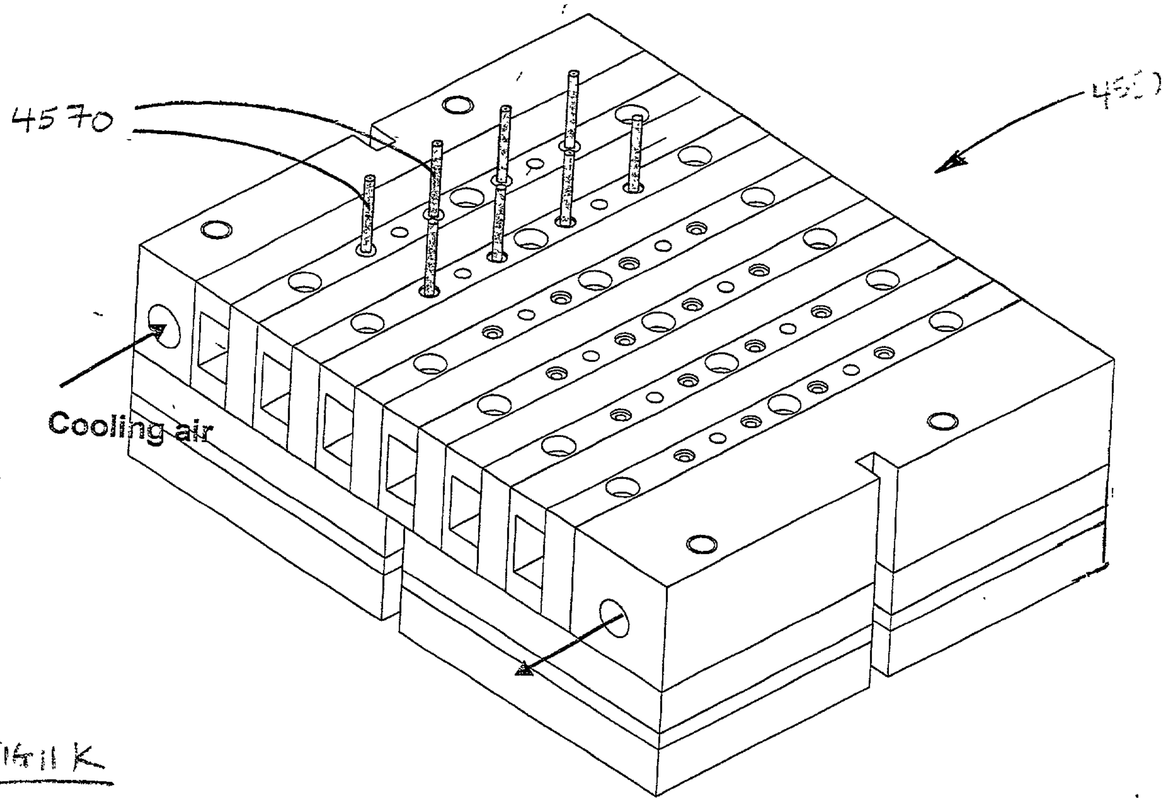

4570
4550
Cooling air

FIG 11K

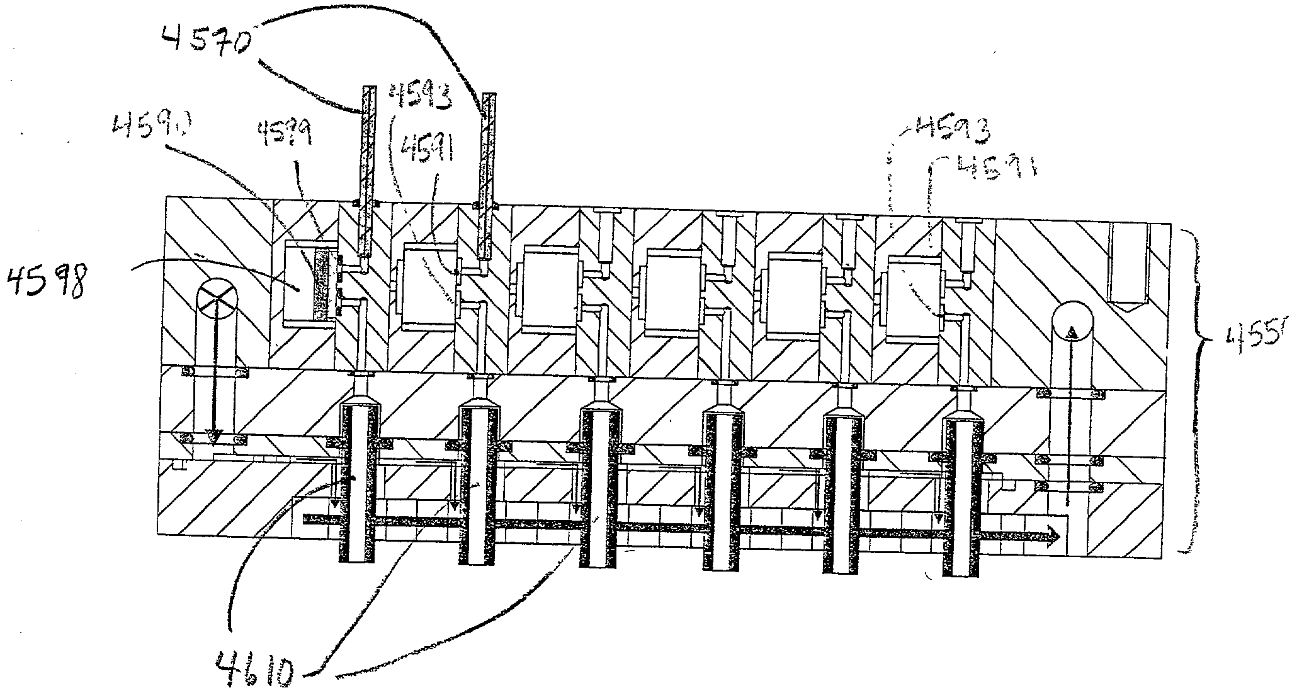

4570
4590
4599
4593
4591
4598
4593
4591
4550
4610

FIG. 11 L

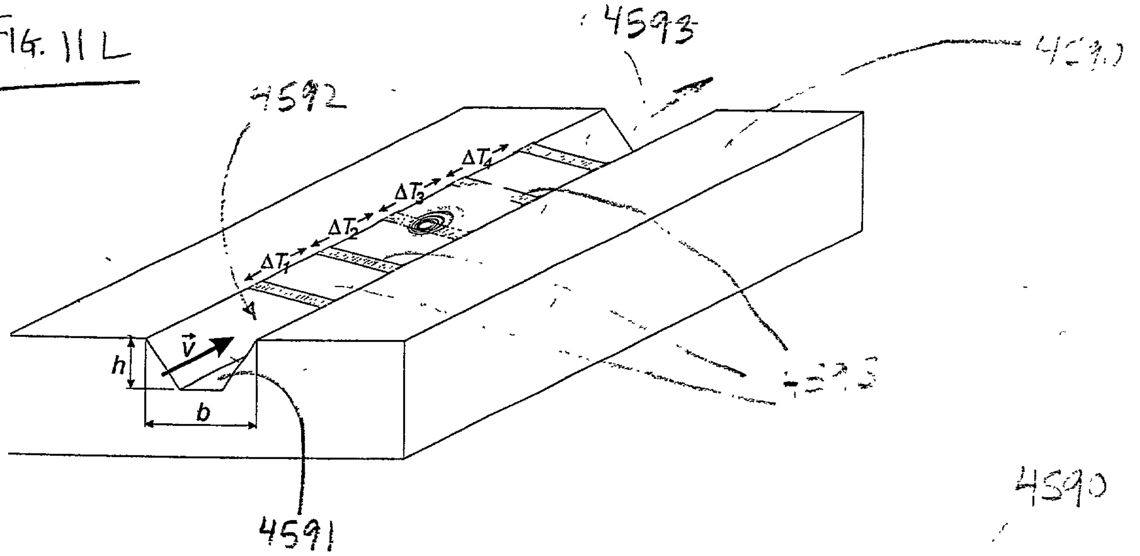

4593
4590
4592
ΔT_4
ΔT_3
ΔT_2
ΔT_1
$\vec{v}$
h
b
4593
4591

FIG. 11 M

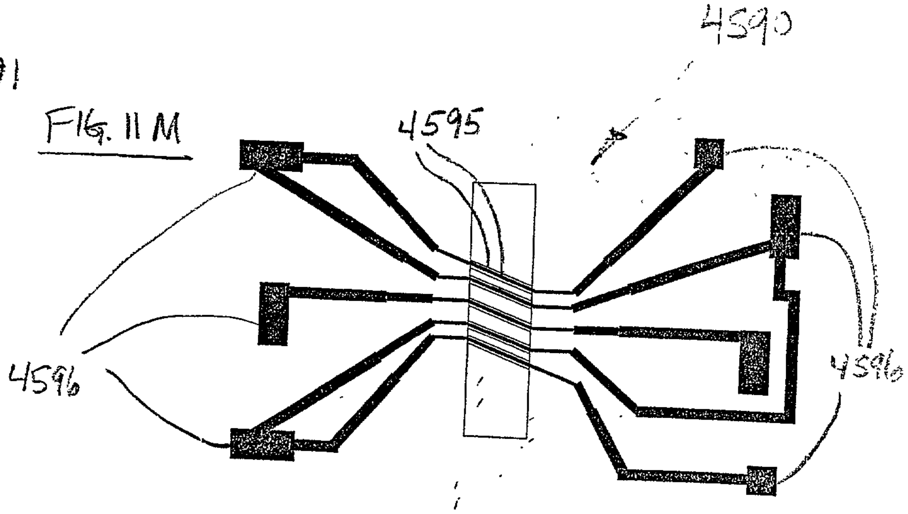
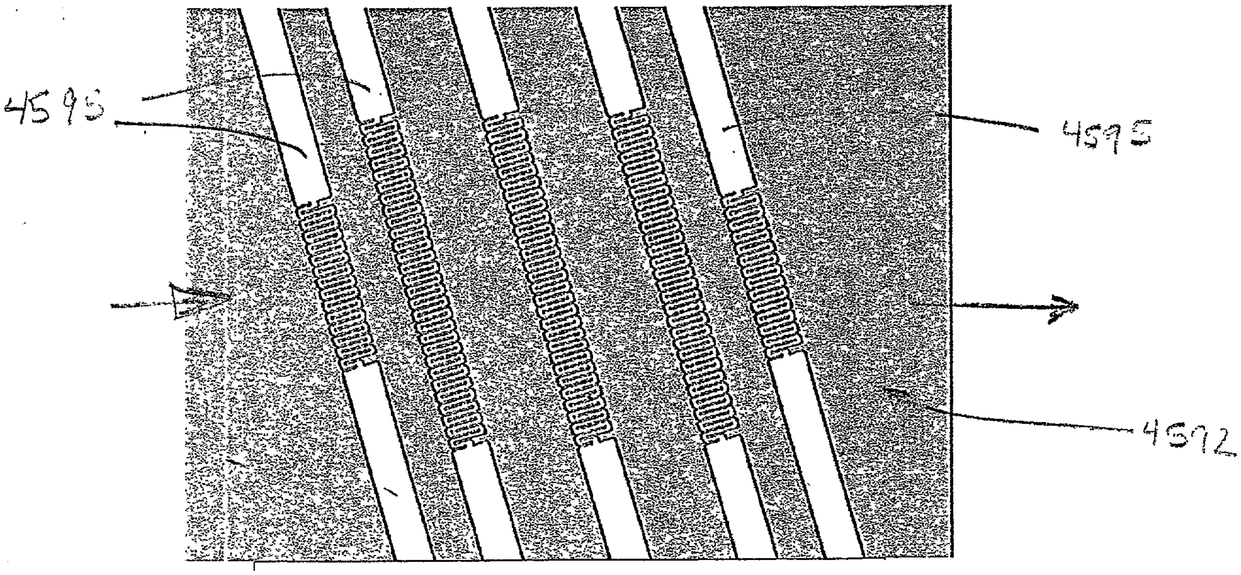

4590
4595
4596
4596
4596

FIG 11 N


4593
4595
4592

09831389.032801

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FIG. 110

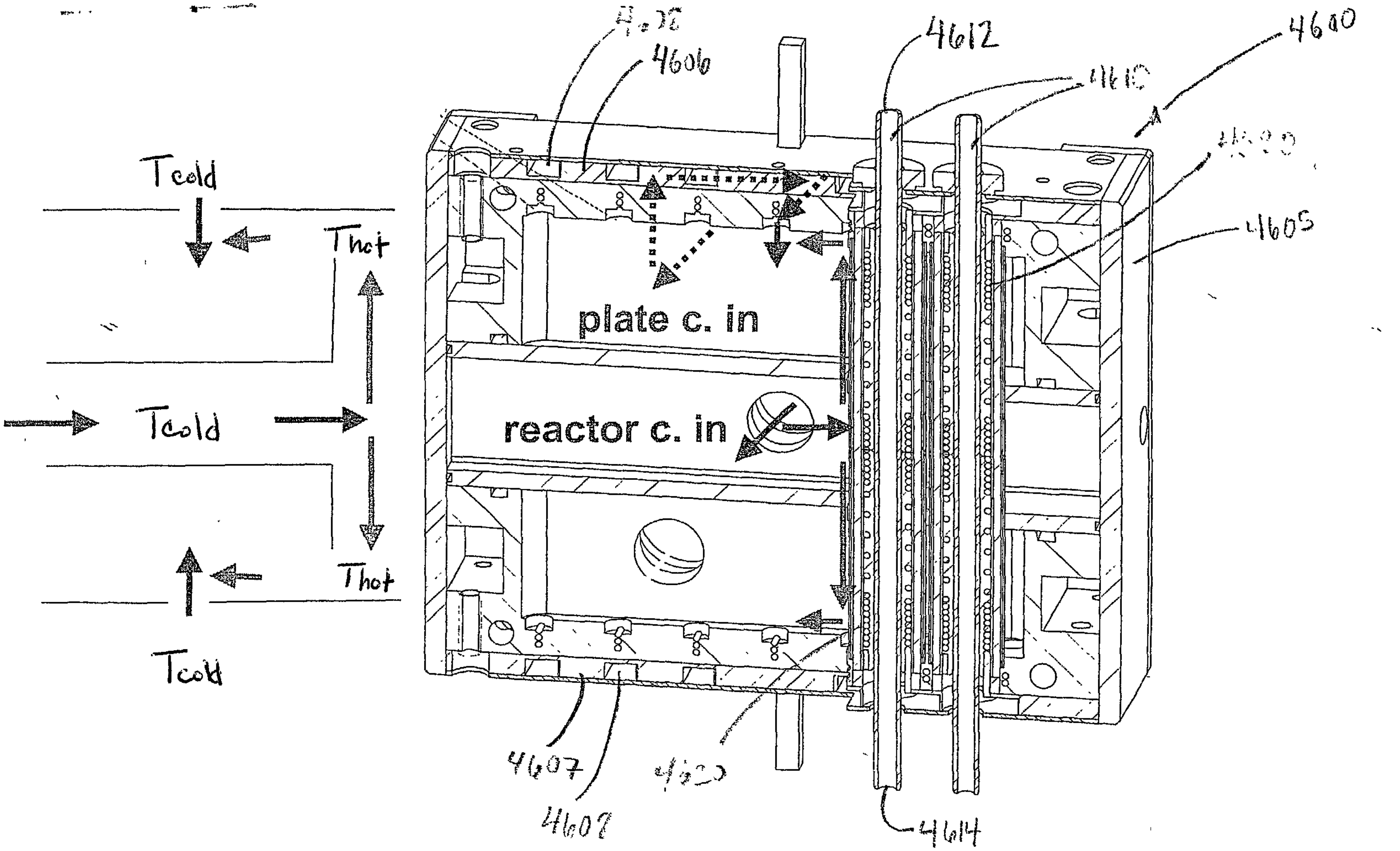
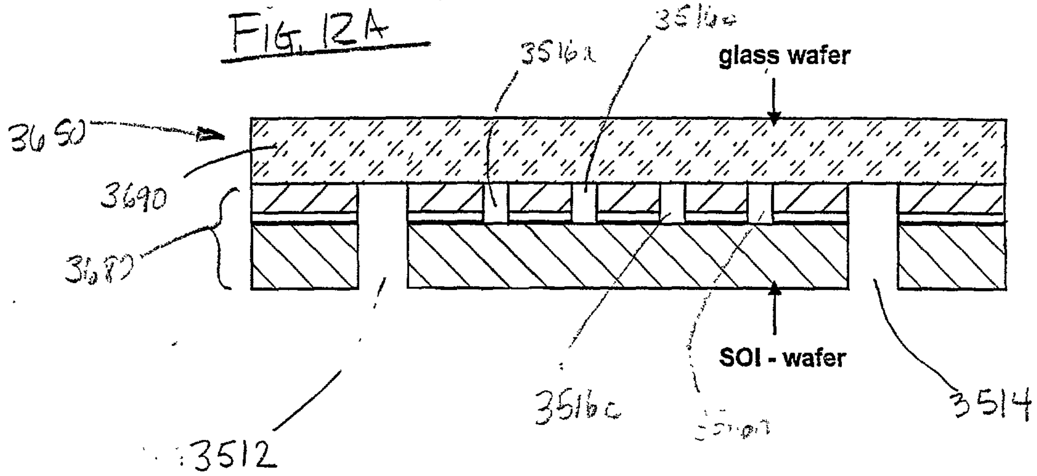

Tcold
Thot
plate c. in
Tcold
reactor c. in
Thot
Tcold

FIG. 12A


glass wafer
SOI - wafer

T080E0"68ET0860

FIG.12B

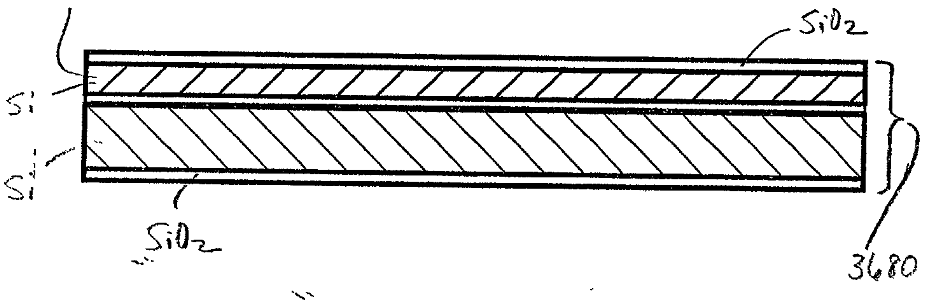

3682
Si
Si
SiO2
SiO2
3680

FIG.12C

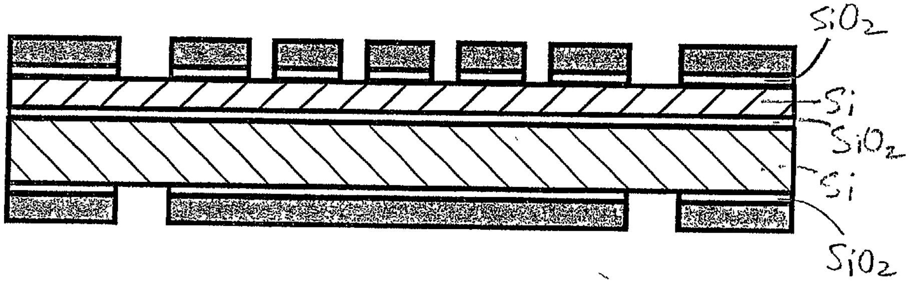

SiO2
Si
SiO2
Si
SiO2

FIG.12D

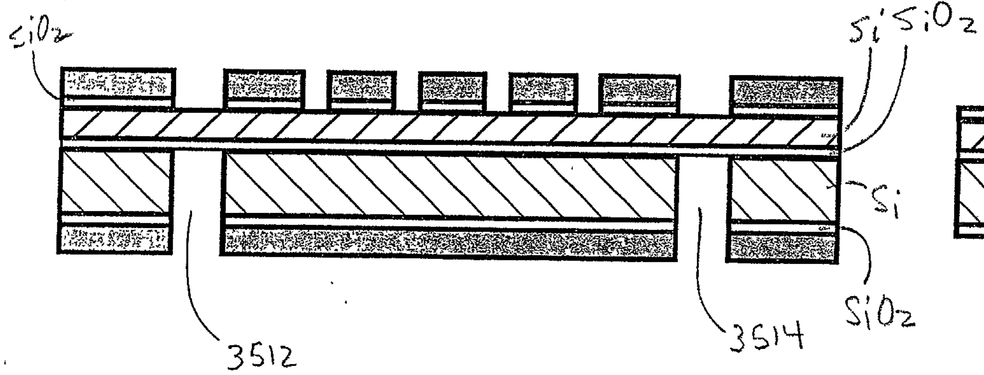

SiO2
Si
SiO2
Si
SiO2
3512
3514

FIG.12E

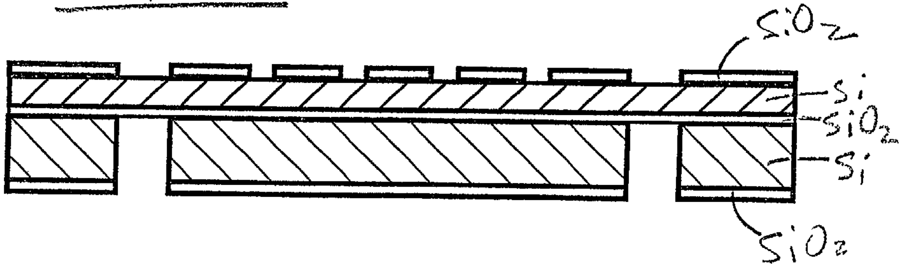

SiO2
Si
SiO2
Si
SiO2

FIG 12F

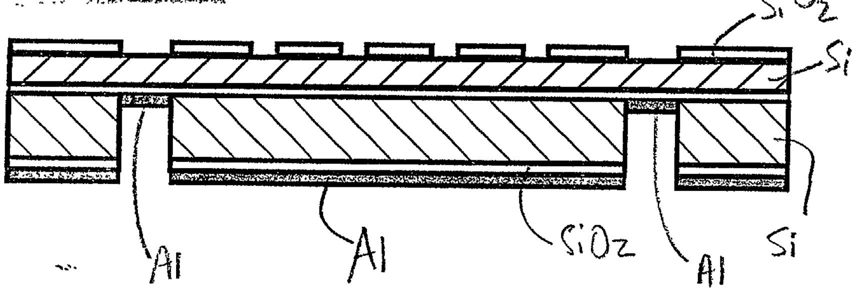

SiO2
Si
Al
Al
SiO2
Al
Si

FIG. 12G

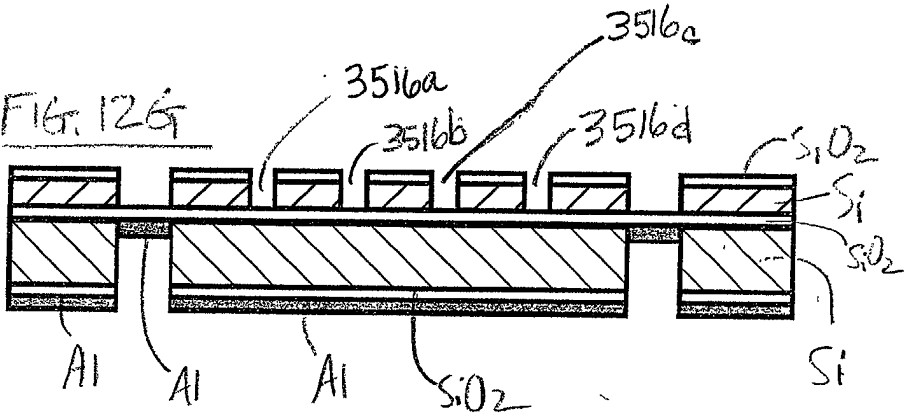
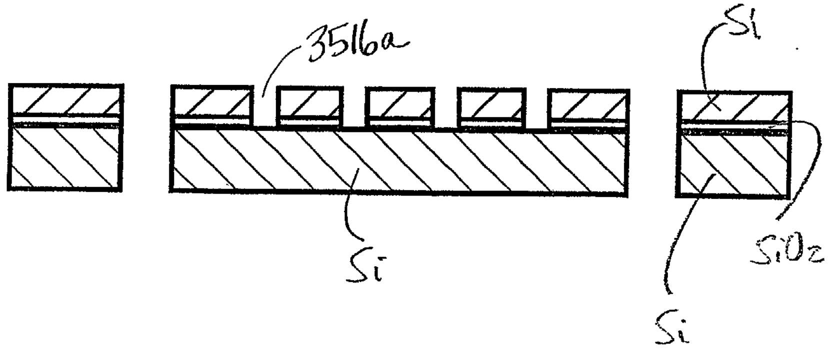

3516a
3516b
3516c
3516d
SiO2
Si
SiO2
Al
Al
Al
SiO2
Si

FIG 12H


3516a
Si
Si
SiO2
Si